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REGRASSING EXPERIMENTS ON DETERIORATED HILL COUNTRY IN WHANGAMOMONA COUNTY

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II. STUDIES ON HOW BEST TO WIN BACK SECONDARY-GROWTH COUNTRY.

THERE are really two main schools of thought in regard to the bringing-back of secondary-growth country. One school claims that crushing with cattle, together with manurial top-dressing wherever this latter practice is possible, is the most economical and direct method. The other holds that it is better and cheaper, eventually, to burn off the secondary growth wherever this is dense enough to carry a fire, sow suitable grass-seed mixtures in the ash, and then maintain by manurial top-dressing the pasture thus formed whenever that practice is applicable. Latterly there has arisen a small school which claims that manurial top-dressing alone will solve the major secondary-growth problems.

The important question to be solved by the research worker—be he a member of some scientific organization or a practical farmer who has been "through the mill"—is how to tackle any area overrun with secondary growth. In the present article of this series I endeavour to outline the different methods that may be adopted, and consider the pros and cons in the light of recent experimental work.

It will be presumed that the country is reasonably well fenced, for, whether one is going to burn, crush, or top-dress, fencing is absolutely prerequisite to the regrassing of secondary-growth country. There are then some eight courses open to the farmer:—

(1) Burning off secondary growth, and sowing suitable grasses and clovers without manure.

(2) Burning and sowing down suitable grasses and clovers, followed by top-dressing with artificial manures.

(3) Burning and sowing no seed, trusting to a satisfactory volunteer grass-growth.

(4) Burning and top-dressing volunteer grass-growth with artificial manures without recourse to further seeding.

These four methods are more or less the practices of the burn-and-sow school, seeding being necessary until the point is reached of having

introduced sufficient grasses and clovers that will volunteer a satisfactory fresh growth after the burn.

(5) Crushing secondary growth with cattle, and trusting to a satisfactory volunteer grass-growth.

(6) Crushing with cattle, accompanied by manurial top-dressing.

(7) Crushing with cattle, accompanied by seeding, with or without manurial top-dressing.

These last three methods belong more to the crushing school. Finally, there is the method of the top-dressing-alone school—

(8) Top-dressing with artificial manures without recourse to burning or seeding.

In the investigation to decide which courses the farmer should take two major questions are kept in view: (1) What is the comparative grassland cover formed after a period of years under each method of treating the country? (2) What is the comparative cost per acre to secure that cover?

(1) Burning and Sowing down with suitable Grasses and Clovers.

If the analyses set out in the accompanying Tables 2, 3, and 4 are considered it will be found that as a result of the seeding alone we have added from 60 up to 80 points of vegetation for every 100 points of the ground-surface examined; in other words, we have covered about two-thirds of the country. Sowing down mixtures recommended in the preceding article (see *Journal* for March last) one can rely on covering about two-thirds of the country by the expenditure of approximately £1 per acre burnt and sown. This is a very satisfactory improvement, and, study the analyses contained in Tables 2 to 5 how we will, we cannot find a greater improvement as far as cover is concerned for any £1 per acre spent on the country in any other way. In the case of analysis No. 5, Table 5, however, where there has been a good 50-point increase in the useful species by the expenditure of £1 per acre on manure, there is little to pick and choose between results. On old, weak turf like this one, still containing fair vestiges of the better species (see analysis No. 4, Table 5), £1 spent on top-dressing is quite an immediately profitable business.

Considering the bare ground recorded in the analyses in Table 3, we find that in No. 1 for every 100 acres burnt and sown on the farm an aggregate of 15 acres is bare and 85 acres is producing feed. In the case of the areas burnt and not sown, and crushed and not sown (Nos. 2 and 3 respectively), approximately only 60 out of every 100 acres are producing feed; in other words, there are 25 acres more of bare ground on the unsown portions than on the sown portions, upon both of which, it must be remembered, £2 an acre has been spent in manurial top-dressing. In the case of the thrice top-dressed area (No. 4), crushed and not sown, 6 acres more per 100 are producing nothing than in the case of the burnt and sown area (No. 1). Again, it will be seen that where three applications of manure were applied there resulted only three-quarters the amount of cover and an increase of 18 points of weeds, compared with the burnt and sown area; while in the case of the two unsown but twice top-dressed areas (Nos. 2 and 3) these were producing at the time of analyses less than one-half the cover of the seeded plot, so far as the useful species are concerned, and from two

and a half to three times as much weed cover. As regards the cost of breaking in, Nos. 1 and 4 have had approximately the same amount per acre spent on them, but the latter has been under treatment a year longer. It might be said also for No. 1 area that the top-dressing of the fern and manuka prior to the burn was largely wasted, although one must admit that seed sown on areas top-dressed prior to the burning does seem to take more readily; one would consider, however, that the manure applied after the burning and seeding would do more good.

It will be noted from Table 4 that the main improvement in the old pasture turf (No. 3) by the £1 spent on manure lies in the great development of the volunteer suckling-clover among the danthonia. Apart, then, from perhaps a general toning-up of the other species, this 35 points of suckling-clover may be regarded as the immediate response due to the top-dressing. In the case of the sown area (No. 1) in the same table the response to the top-dressing has largely been in the promotion of a splendid growth of white clover, together with a healthy stand of brown-top, crested dogstail, and some rye-grass and Lotus major, which combination, in my opinion, has a better feeding-value than the danthonia, Yorkshire fog, sweet vernal, and suckling-clover combination of the old pasture top-dressed. Certainly I would consider that any more money spent in further top-dressing either of these

Table 2.—Analyses of Turfs formed by the Burning-off of Secondary Growth followed by Seeding, with and without Manurial Top-dressing.

Amounts given in table heads as spent on seed or manure are all per acre.

Species recorded.	No. 1. Mixtures 1–6, 1926, 9 months old; £1 on seed. (Coxhead.)	No. 2. Mixtures 1–6, 1926, 9 months old; £1 on seed, £1 on manure. (Gill.)	No. 3. Mixture 2, 1924, 3 years old; £1 on seed, no manure. (Coxhead.)	No. 4. Mixture 2, 1924, 3 years old; £1 on seed, £1 on manure. (Raughan.)	No. 5. Mixture 7, 1924, 3 years old; £1 on seed, £2 on manure. (Coxhead.)	No. 6. Mixture 2, 1924, 3 years old; £1 on seed, £2 on manure. (Barwick.)
Bare ground ..	30 per cent. Points.	15 per cent. Points.	20 per cent. Points.	10 per cent. Points.	9 per cent. Points.	6 per cent. Points.
Brown-top ..	33	36	32	55	38	48
Crested dogstail ..	20	23	12	9	12	10
Cocksfoot ..	1	3	2	1	4	1
Perennial rye-grass	2	5	2	3	3	2
White clover ..	3	5	4	2	1	10
Lotus major ..	0·3	0·3	14	37	34	6
Lotus hispidus ..	1	0·5	2	0·2	2	0·4
Danthonia pilosa ..	1	0·3	8	1	0·5	5
Paspalum ..	Trace	..	1	6	4	1
Subterranean clover	0·2	0·5	..	1	4	1
Yarrow	1	1	1	0·2	1	1
Poa pratensis .	..	..	..	1	5	4
Chewings fescue ..	..	..	2	1	0·5	..
Red clover ..	..	..	..	..	1	1
Suckling-clover ..	4	14	6	3	4	20
Yorkshire fog ..	4	3	6	3	3	5
Catsear	3	3	11	4	10	9
Other weeds ..	10	16	5	5	11	16
Summary.						
Bare ground ..	30 per cent. Points.	15 per cent. Points.	20 per cent. Points.	10 per cent. Points.	9 per cent. Points.	6 per cent. Points.
Useful species introduced by seeding	62	75	80	116	101	85
Useful volunteers..	8	17	12	7	16	30
Weeds	13	19	16	9	21	25
Total points ..	83	111	108	132	138	140

two turfs would be more profitably spent on keeping the sown portion going strongly.

From a further study of these tables, if one compares the swards derived from the various methods employed, it is seen that a good range of species is secured from the burning and seeding, so that, whatever the pasture management, one species or more is established to meet any change in the habitat that may arise. If top-dressing can be systematically carried out there are present on the sown country species that are capable of big response; on the other hand, if top-dressing is not practicable, then the danthonia established as a result of the seeding is there to carry on after the fertility contained in the ash of the burn has become depleted. Compare, for example, the analysis No. 1 in Table 3 with Nos. 2, 3, and 4 In No. 1, under top-dressing, all the better species are present in sufficient quantities to make really first-class pasture, whereas in Nos. 2, 3, and 4 the only species that has established itself in sufficient quantity to do much good is the white clover; and with these plots it is a case of continual top-dressing, or rapid deterioration will again soon set in. In No. 1, Lotus major, an important species to get going throughout secondary growth, is well established, whereas there is none in the other three plots. Again, after eighteen months, 3 points of danthonia are recorded

Table 3.—Analyses of Turfs formed by different Methods of breaking in Country.

All plots except No. 5 situated in same paddock; No. 5 on similar type of country.

Species recorded.	No. 1. Burnt and sown 1925, mixture 6; 3 cwt. slag prior to burn, and 3 cwt. after seed sown; £3 per acre spent.	No. 2. Burnt 1925; no seed sown; same top-dressing as No. 1; £2 per acre spent.	No. 3 Not burnt or sown, but crushed out; same top-dressing as Nos. 1 and 2; £2 per acre spent.	No. 4. Not burnt or sown, but crushed out; top-dressed three times with 3 cwt. slag; £3 per acre spent.	No. 5. Burnt and sown 1925, mixture 4; no top-dressing; £1 per acre spent.
Bare ground ..	15 per cent. Points.	43 per cent. Points.	39 per cent. Points.	21 per cent. Points.	20 per cent. Points.
Brown-top ..	22	..	0·2	1	34
Crested dogstail ..	11	..	..	3	9
Cocksfoot	5	4	3	11	0·4
Perennial rye-grass ..	7	1	..	1	5
White clover ..	38	17	19	23	7
Lotus major ..	13	..	..	..	4
Lotus hispidus ..	0·4	..	..	..	0·4
Paspalum	..	..	..	..	2
Danthonia pilosa ..	3	..	0·2	..	20
Subterranean clover ..	0·2	..	..	..	..
Yarrow	1	0·4	0·4	3	2
Suckling-clover ..	6	14	2	8	0·2
Yorkshire fog ..	1	5	4	22	1
N.Z. rice-grass ..	0·2	2	11	2	..
Catsear	2	11	5	10	4
Cudweed	2	2	9	1	2
Hawkweed ..	2	3	6	5	2
Other weeds ..	4	6	13	12	6
Other grasses ..	0·4	1	2	0·2	..
Other clovers ..	1	1	0·4	0·4	..
Summary.					
Bare ground ..	15 per cent. Points.	43 per cent. Points.	39 per cent. Points.	21 per cent. Points.	20 per cent. Points.
Useful species introduced by seeding	101	..	..	..	84
Useful volunteers ..	8	45	42	75	1
Weeds	10	22	33	28	14
Total points ..	119	67	75	103	99

NOTE.—Analysis No. 5 done 22nd February, 1927—three months later than Nos. 1–4.

in the sown and manured plot, and on the sown and not-manured plot after twenty-three months 20 points of danthonia are recorded ; whereas in the other three plots not sown there is but a trace in one of them, and this after three to four years' crushing. The establishment of danthonia is the best guarantee against deterioration in any hill country that cannot be top-dressed, and may be considered as one of the major questions throughout the more difficult Taranaki back-country. Burning and seeding of the burn does enable a fairly rapid establishment of this grass to take place.

If we examine the analyses in Table 4, and compare No. 1 with No. 2, the evidence in favour of sowing is overwhelming. Both these plots have been top-dressed since the secondary growth was burnt off, and there are shown to be 83 points of useful vegetation on the burnt and sown portion, as against only 18 points of useful volunteers on the burnt and unsown portion.

In dealing, then, with the first question—whether one should burn and sow—in my opinion the answer must be in the affirmative for the general run of the hill country. Farmers starting to break in secondary-growth country should burn as late in autumn as possible, and sow immediately one or other of the seed mixtures recommended on page 162 of the March *Journal*. Exceptions, where seeding after the burn is not advisable, are dealt with later in the present article.

Table 4.—Analyses of Turfs formed by Burning, Seeding, and Top-dressing, compared with Burning and Top-dressing without Seeding.

All plots in same paddock, but No. 4 on a different aspect.

Species recorded.	No. 1. Burnt and seed sown 1926, mixture 3; top-dressed 1926, 3 cwt. slag; £2 per acre spent.	No. 2. Burnt but not seeded; top-dressed as No. 1; £1 per acre spent.	No. 3. Old turf adjacent to Nos. 1 and 2: same top-dressing; £1 per acre spent.	No. 4. Burnt but not sown, 1925; 3 cwt. slag 1925; 3 cwt. basic super. 1926; £2 per acre spent.
Bare ground	18 per cent. Points.	43 per cent. Points.	14 per cent. Points.	26 per cent. Points.
Brown-top	18	..	..	..
Crested dogstail	14	..	..	..
Cocksfoot	1	2	4	..
Perennial rye-grass	3	..	..	..
White clover	33	1	..	1
Lotus major	2	..	..	..
Danthonia pilosa	1	1	33	23
Suckling-clover	8	3	35	26
Yorkshire fog	3	11	10	8
Sweet vernal	4	16	10	13
Hairgrass	1	1	0·4	8
Catsear	9	7	17	7
Cudweed	1	8	2	1
Hawkweed	3	8	1	1
Other weeds	4	8	11	15
Other grasses	0·2	..	..	2
Other clovers	0·6	..	..	..
Summary.				
Bare ground	18 per cent. Points	43 per cent. Points.	14 per cent. Points.	26 per cent. Points.
Useful species introduced by seeding	72	..	..	..
Useful volunteers	12	18	82	58
Weeds	22	48	41	47
Total points	106	66	123	105

Table 5.—Analyses showing the varying Responses by Manurial Top-dressing on Two different Classes of Old, Run-out Pastures.

Species recorded.	Danthonia dominant, following on Years of Crushing.			Weak, Worn-out Pasture Remnant of the Old Sown Turf.		
	No. 2. Before top-dressing.	No. 2. First year after top-dressing; £1 per acre spent.	No. 3. Second year and after second top-dressing; £2 per acre spent.	No. 4. Before top-dressing.	No. 5. First year after top-dressing; £1 per acre spent.	No. 6. Second year and after second top-dressing; £2 per acre spent.
Bare ground ..	22 per cent. Points.	22 per cent. Points.	14 per cent. Points.	20 per cent. Points.	8 per cent. Points.	6 per cent. Points.
Cocksfoot ..	3	4	3	8	5	7
Crested dogstail ..	..	..	..	..	1	1
Perennial rye-grass	0·3	..	..	3	3	6
White clover ..	..	..	2	3	34	58
Suckling-clover ..	1	5	23	3	23	22
Red clover ..	..	..	0·3	..	1	1
Lotus major ..	..	..	..	0·3	0·3	1
Timothy ..	..	..	..	..	..	1
Poa pratensis ..	2	0·3	..	3	7	5
Danthonia pilosa	47	54	49	1	..	0·3
Yorkshire fog ..	6	8	9	9	7	13
Sweet vernal ..	19	11	14	16	20	21
Catsear ..	16	9	18	27	17	13
Rib-grass ..	1	1	1	2	6	9
Cudweed ..	1	..	0·6	6	6	3
Selfheal..	2	3	0·3	8	3	2
Other weeds ..	8	..	7	4	5	3
Summary.						
Bare ground ..	22 per cent. Points.	22 per cent. Points.	14 per cent. Points.	20 per cent. Points.	8 per cent. Points.	6 per cent. Points.
Useful species ..	59	71	86	30	81	115
Weeds	47	24	41	63	57	51
Total points	106	95	127	93	138	166

(2) Burning and Sowing with suitable Grasses and Clovers, followed by Top-dressing with Artificial Manures.

Burning and seeding alone involves the ability to crush. It is therefore the practice of the larger landholder, who has at his disposal all the hoof-power that is required. The plan of the smaller holder, who cannot afford to crush so hard on account of the cattle losses, lies more in the promotion of a greater amount of more palatable feed on a given area, so that he can hold the necessary stock there to deal with reappearing fern, &c., without the forcing necessary on areas where feed is more scanty and less palatable. This brings up the second question, Should the country be top-dressed with artificial manures after burning and seeding?

The question of top-dressing the burn immediately following the seeding and subsequently is a very big one. There is so much country that is quite inaccessible to the top-dresser that to affirm the essentiality of all areas burnt and sown being also top-dressed must needs exclude the hope of many large areas ever being tackled. My firm conviction in regard to this regrassing work is this, that if one can only keep secondary-growth country open to the light by burning or by crushing for a period of from five to ten years, Danthonia pilosa, provided it is introduced early in the process, will grass that country, and the more rapidly danthonia can become established the quicker will the grassing of the country become. The initial burning of the secondary growth

and the sowing-down of the burn afford an initial opportunity for getting this grass established, and that opportunity should on no account be lost.

Now, there are always on these farms closer and more accessible portions, and the question here is whether one should be satisfied with the danthonia turf or aim at a combination of better species. With a reasonable amount of top-dressing following the seeding one can rely on retaining a good turf of brown-top, crested dogstail, Lotus major, and white clover, with a small proportion of rye-grass, cocksfoot, and Poa pratensis; and here is where top-dressing plays a part. The objective should be to top-dress after burning and seeding all of the easier and more accessible country, so as to maintain the sward of brown-top, crested dogstail, Lotus major, &c., and to get danthonia established by the cheapest and quickest method possible on the higher and more inaccessible and poorer parts of the farm. Suppose one does get danthonia dominant over the greater part of the farm, and then finds that one can extend the top-dressing, in my opinion it would be far better to spend money on top-dressing a danthonia-dominant sward, even though the immediate response might not be great, rather than spend the money on top-dressing weeds, bare ground, and secondary growth.

It is rather difficult to decide from the analyses whether, if a farmer had, say, £50 to spend, it would be better to burn and sow, say, 50 acres of secondary-growth country and use the money on seed alone, or to burn 25 acres and spend £25 on seed and £25 on manure. Comparing analyses Nos. 1 and 2, Table 2, one sees that for every 100 acres burnt and sown 15 acres more is covered by pasture on the top-dressed area, and taking into consideration all the vegetation there is an increase of approximately one-third. The species sown have increased by 12 points per 100, and the volunteer useful species have doubled, the increase being due to the greater growth of suckling-clover Then, again, it must be borne in mind that if one can make 1 acre produce what 2 acres do normally one is more than doubling the net income from that area, for there is interest, rates, maintenance, costs, &c., to be paid only on 1 acre instead of 2. Further, the effect of the top-dressing may well be expected to last for at least three years, so that if the increase of vegetation each year is anything like one-third increase over the un-topdressed portion, then the top-dressing must be regarded as being a payable proposition.

Further, if one compares the three-year-old turfs—Nos. 3, 4, and 5, Table 2—it will be seen again that roughly there is an increase of one-third in the number of points recorded. In the one case the increase was largely in the species sown, and in the other mainly in the useful volunteers, suckling-clover contributing the greater part. This difference in response by the different species is largely due to the farm-management. Nos. 3, 4, and 5 have been rotationally grazed, and never at any time have these areas been closely and continuously grazed for long periods. In the case of No. 6, close and continuous grazing has been carried on during the three years that these plots have been in existence. The varying response by certain species in particular is interesting under the two systems. Spelling for a period coupled with top-dressing stimulates greatly the development of Lotus major, which when allowed to get away rank suppresses greatly the white clover and the suckling-clover. The close grazing checks the Lotus-major development and encourages the development of white clover and suckling-

clover, provided top-dressing is being done. This is well seen in these analyses. The close and continuous grazing also increases more rapidly the development of danthonia. While deprecating generally close and continuous grazing, one has little objection to raise in the case of turf No. 6, for the 36 points of white clover, Lotus major, and suckling-clover make a very nicely balanced ration—better, one would think, than the more dominant Lotus major of the other plots. It is a point that needs careful study, and from these figures it would appear that it is better to control the Lotus-major development somewhat by heavier stocking, so that the white clover and the suckling-clover may not be smothered out by the rank growth of which Lotus major is capable when top-dressed.

There is no doubt that these top-dressed plots are very good, and the low percentage of bare ground testifies to the splendid cover secured on them. If only it were practicable for all secondary growth to be burnt, seeded, and top-dressed the troubles connected with it would be largely at an end.

As regards the small holder, I can see very little hope of his country being broken in except he overfences to an unprofitable degree—unless he top-dresses every acre burnt and sown. For the small holder top-dressing after burning and seeding means control of reappearing secondary growth without the cattle losses that must inevitably follow forced crushing. With the larger holding, as before stated, the position is quite different. The holder can burn and sow in big blocks; he can hold and crush in large paddocks; and he can afford to produce less per acre and to wait longer for the necessary development of the hardier grasses that make for the ultimate cheaper working of the country. I am not prepared to say that the small holder cannot make a good living off hill country, but his method of tackling the land must conform to fairly definite principles, whereas the large holder can take many more liberties with the country—provided always he has the necessary stock and equipment to manage a large holding. Large holdings inefficiently equipped will, of course, deteriorate even more quickly than will the small holding. I have referred to this matter here because I believe it draws a very definite line between those areas that can only satisfactorily be brought back by burning, seeding, and manuring, as against those that may be brought back by seeding only followed by crushing, or even by crushing alone.

(3) Burning and Sowing no Seed, trusting to a Satisfactory Volunteer Grass-growth.

While recommending in general the sowing of all burns at the present time in the Taranaki back-country so as to introduce species suitable to that country, the final objective is to be able to burn off any secondary growth or crush it out and get a volunteer return grass-growth of suitable species, in order that ultimately very little more seed, if any, need be sown. The species most useful in this respect are Danthonia pilosa, brown-top, Lotus major, Poa pratensis, suckling-clover, Yorkshire fog, and, on the sunny aspects and warmer country, paspalum. Suckling-clover and Yorkshire fog are already sufficiently well established, and danthonia is now making headway, but its progress is slow. Brown-top, Lotus major, and paspalum are the three less common species. Once these species are well established among any

secondary growth or immediately adjacent to it, then the seed-bag can be withheld; but until then every effort should be made to get one or other, or all, truly established on the area. Just which ones will ultimately persist depends largely on the farm-management, particularly in regard to top-dressing and stocking.

With regard to this method of establishing on the country species that will volunteer to return once the shade of the secondary growth is removed by burning or crushing, the analysis shown for plot 4, Table 4, is interesting, and will serve to make clearer the ultimate aim. The hard-fern patches on which the analysis was made were burnt in 1925. They are situated on a hard sunny face where danthonia is dominant up to the edge of the hard-fern patch, and some danthonia was even persisting or lingering in the hard fern itself. These patches were burnt and not sown, so as to study the volunteer return growth. The danthonia recorded is largely from the original plants that were lingering in the hard-fern cover. With the letting-in of the light these plants almost immediately took on a stronger growth, and an examination of the bare ground in December, 1926, showed numerous danthonia-seedlings established; in fact, more young plants per acre were established as volunteers from seed shed than could have been secured from the artificial sowing of some 10 lb. or more per acre. With these patches now it is only a matter of keeping the turf open to the light by further burning or crushing and the country will be grassed. The amount of 26 points of suckling-clover on this area is also volunteer growth, and is due almost entirely to the top-dressing.

From the foregoing it will be seen that the answer to the third question, whether to burn and trust to a satisfactory volunteer grass-growth, depends largely on whether there are any satisfactory plants lingering on the area that will respond as volunteers.

In No. 2, Table 3, and in No. 2, Table 4, the analyses show a poor volunteer growth considering that these plots have been top-dressed, and in both these instances I certainly would recommend that seeding should follow burns of such nature. In the case of plot 4, Table 4, the treatment will ultimately give a complete cover of volunteer danthonia; but in this case, where top-dressing is being carried out, I would have advised the sowing of some seed of brown-top, crested dogstail, Lotus major, and white clover. Without top-dressing, however, when one sees danthonia as a dominant throughout the country, and where stunted sweet vernal and hair-grass come away as volunteers along with the danthonia after the burn, one must admit that to sow seed of any species on such country is decidedly wasteful unless top-dressing can be carried out. Here, again, to top-dress the poorer country first in the hope of getting something a little better than danthonia is not good business while there are other areas on the farm that would better repay the money spent on top-dressing them. For example, £2 spent in top-dressing on this turf (No. 4, Table 4) resulted only in an increase of some 27 points, most of which is suckling-clover. Compare also in this respect the responses secured from top-dressing the two areas shown in analyses Nos. 2 and 3 and 5 and 6, Table 5. Unquestionably the poorer and harder country gives the least response, both in the matter of seeding and of top-dressing; and there is a line somewhere in soil-qualities below which it does not pay to top-dress or to sow seed after secondary burns. In these cases hardy grasses like danthonia or ratstail, established by the cheapest possible means, should be the objective.

(4) Burning, and Top-dressing Volunteer Grass-growth with Artificial Manures.

The only condition under which one would recommend the top-dressing of secondary-burn country without seeding is, as indicated in the heading, when there is a good volunteer growth of permanent grasses and clovers. Referring again, for example, to analysis No. 2, Table 4, where 3 cwt. of slag per acre has been applied, it will be seen that nearly half the area is bare ground from which there is no response, and of the remaining half two-thirds consists of weeds and one-third of second-rate grasses, mainly Yorkshire fog. Does this response justify the expenditure of £1 per acre in top-dressing? In the case of No. 4, Table 4, there certainly is some justification for the top-dressing, although, as before stated, it is very doubtful if the money used for the top-dressing was well spent.

Top-dressing after secondary burns, without seeding, is justified only when the volunteer growth consists of species that can respond. Brown-top, Lotus major, paspalum, and suckling-clover come well within this category, and I would unhesitatingly recommend the top-dressing of such volunteer growth. In the case, however, of danthonia, weak Yorkshire fog, stunted sweet vernal, hair-grass, and sparse suckling-clover, top-dressing is very problematical, to commence with at any rate, while the top-dressing of virtually no sole at all must be absolutely unsound. Top-dressing can only promote—it cannot create.

It will therefore be seen that I advocate leaving the hardest and poorest country severely alone, as far as spending money directly on it is concerned, until such time as the better portions of the farm are producing their maximum. Then, with money derived from the greater returns of the better country as a result of the top-dressing, a start may be made towards improving the poorer land. If top-dressing is found not to return a profit on the better portions of the farm it certainly will not do so on the poorest.

(5) Crushing Secondary Growth with Cattle and trusting to a Satisfactory Volunteer Grass-growth.

Is it advisable to crush with cattle and trust to a satisfactory volunteer grass-growth? At the present time—in the Taranaki back-country at least—crushing with cattle leads to hard fern. Most of the country now in bracken, manuka, &c., has been more or less through the hard-fern stage, and throughout such country there still linger remnants of this troublesome growth. Hard fern lingers in just the same way as does danthonia, brown-top, Lotus major, or paspalum, and as soon as the shade of the taller secondary growth is removed by the slashhook or by the crushing of cattle hard fern at once becomes strong and vigorous again; and, owing to the fact that there is little or no competition from any turf sown, its spread over the bared ground is very rapid. I have seen areas bared of secondary growth almost completely covered with hard fern within three years of being crushed out. The rhizome of these hard-fern remnants are right on the ground-surface, and a hot fire which can be secured before any crushing has been done kills these old plants outright. Although there is still sporeling infection to contend with after the burn, yet, provided grass-seed is sown, quite a good sward may be formed before these plants develop to any size. Hard fern is an exceptionally good example of an undesirable volunteer, and it is induced very largely by crushing.

Where one has the hoof-power to crush rapidly the hard-fern remnants may be largely destroyed, but when crushed slowly, little by little, there is nothing surer than a hard-fern association making a reappearance.

The crushing of bracken on country where hard fern does not make its appearance — usually country with under 60 in. of rainfall — or on poor, light country, is an entirely different matter. Thousands of acres of bracken-fern country have been converted into danthonia country or brown-top country by the mere crushing with cattle. It can be equally well said that thousands of acres of similar secondary growth have been also converted to danthonia or brown-top by the repeated burning-off of the bracken without a hoof of cattle being employed

Successful crushing with cattle without recourse to burning or seeding is, as before mentioned, confined almost entirely to the large holding where the loss of a few hundred head of cattle is regarded as the price paid to clean the country. The small holder also often attempts to crush, and over the easier portions of the farm this may be fairly successful; but when it comes to really forcing the cattle on to the more difficult portions the small man either has not the necessary number of cattle or he cannot bear the financial losses that occur as soon as cattle are really forced.

Fencing into small paddocks, of course, enables the small holder to crush, but at the present time we know very little of the economics of fencing hill country into paddocks sufficiently small for this purpose. No doubt the adherents of the crushing school have plenty of backing from their successes in the past, but in many cases I firmly believe that had the country been burnt and sown prior to the crushing there would have been considerably less loss in cattle and a better mixed-pasture sward would have resulted.

Even when areas are burnt and sown, crushing to some extent is still necessary, and the ability to crush or to hold the country is the deciding factor between success and failure. A dense return of secondary growth will kill all pasture species sown, particularly if it comes back before these get well established. Here, again, the large holder with his hundreds of cattle has the problem as it were in the hollow of his hand. Not so the small holder, to whom the loss of one cattle-beast may be regarded as a misfortune. The power to crush and to crush at the right moment is indispensable for the economic breaking-in of secondary-growth country.

If the present discussion seems to give hope for the successful regrassing of most of the hill country of the type here dealt with, I must nevertheless stress the futility of spending any money on sowing burns unless the farmer is confident that he has the necessary power, either in the form of cattle for crushing, or in the form of manures for stimulating increased feed with which to maintain more stock per acre on the slopes burnt and sown. Many a good effort will end in nought unless this provision is made beforehand. The same applies also in the matter of fencing.

One of the great disadvantages of crushing without sowing is that it does not allow of control or selection of the pasture species. It is all a matter of chance, and, until danthonia comes in, bare ground, weeds, and inferior grasses are usually dominant. Yorkshire fog, sweet vernal, catsear, hawkweed, and cudweed are usually the first fruits of crushing.

Clovers appear in quantities only if the soil is fertile or if top-dressing is being carried out. If there was a certain amount of danthonia lingering in the secondary growth before crushing, this volunteers fresh growth, the plants by reseeding and vegetative spread gradually thicken up the turf, and in from six to ten years danthonia becomes almost universally dominant, bearing out that if only light can be admitted to the ground-surface this grass will ultimately come in and take charge.

From six to ten years, however, is a long time to wait, and during this period crushing has to be faithfully carried on, whereas in the case of burning and sowing and manuring the same number of stock can be maintained on the area sown without so much forcing and without the subsequent losses by death. This is where burning and sowing and subsequent top-dressing may be regarded as all to the benefit of the small holder. He can do his work better, he can get immediate return, and can control secondary growth by providing enough feed to keep a sufficiency of stock working without undue forcing.

Again, in a wet climate like that of the Taranaki back-country, unless some danthonia is sown or otherwise introduced, it may be considerably over ten years before a good danthonia sward is formed, and one naturally asks what is going to cover the ground in the meantime. This can be very largely answered by referring to analyses shown in Table 3. In the case of No. 3, had this area not been top-dressed the white clover and suckling-clover most certainly would have been absent, which would have left some 21 per 100 points examined of useful vegetation, consisting of New Zealand rice-grass and Yorkshire fog. Danthonia is just making its appearance, and it will be a matter of from six to ten years' work crushing this area before the sward of danthonia and rice-grass ultimately takes charge. In the case of plot 4, which has been crushed for four years, if one takes out the clover, the increase of which is entirely due to the top-dressing, there remains some 44 points of useful volunteers, mainly Yorkshire fog (22 points) and cocksfoot (11 points), most of this latter increase and a good deal also of that of the Yorkshire fog being due to the top-dressing.

In cases where there are obviously good species lingering among the secondary growth, particularly cocksfoot, then crushing undoubtedly is preferable to burning; and where such species as brown-top, Lotus major, paspalum, and danthonia are obviously well scattered throughout the secondary growth it matters not whether the area is crushed out or burned, for any of these will carry a fire well, whereas cocksfoot does not do so.

Another point in crushing as compared with burning is that such growth as manuka is more effectively dealt with by burning. On plots 3 and 4, Table 3, quite a large amount of manuka was making its appearance, both from plants that were too small to cut at time of clearing and from the base of the smaller cut bushes. In plots 1 and 2, that were burnt, no living manuka is present. At the time of my last visit pulling of this reappearing manuka had commenced on the unburnt but crushed plots, which would soon put another £1 per acre on to the breaking-in cost. What has been said in the foregoing remarks regarding burning *versus* crushing holds good only while the destruction of secondary growth remains the main objective. Once the grass sward is formed any roughage in this should be cleaned up by cattle in preference to burning it off.

(6) Crushing followed by Top-dressing.

Referring again to the analyses 3 and 4, Table 3, some idea can be obtained of the effect of top-dressing after crushing on this particular class of country. In these plots, if one puts down the clover increase as the immediate effect of the top-dressing, it is found that by the expenditure of approximately £2 and £3 per acre respectively the vegetation on these plots has been increased by 21 points in the first case and 31 points in the second. No doubt in the second case also the 11 points of cocksfoot and a certain increase in the Yorkshire fog have been largely due to the top-dressing. These are the bare facts, and, although the piece of ground on which these trials were conducted happens to be some of the poorest in the district, the results do not justify confidence in the top-dressing of any dense secondary-growth country in conjunction with crushing. After all, is it reasonable to spend valuable time and money top-dressing virtually bare ground and inferior vegetation in the hope that one day some more useful plants will ultimately put in their appearance? Where there exists within the secondary growth a sufficiency of suitable grasses and clovers that are capable of responding immediately to the top-dressing, then, of course, one may look forward confidently to a payable return from top-dressing in conjunction with crushing. But in dealing with dense secondary growth, if one is in a position to manure, my firm conviction is that such growth, wherever it is dense enough to carry a fire, should be burnt and sown prior to the manuring.

There is no doubt that top-dressing is a vital factor in production—perhaps the greatest single factor in production at the present time; but, owing to its varying responses when applied to various classes of soil, care must be exercised to ensure that the money is spent to the very best advantage. "Top-dress the best country first" is an axiom for all top-dressers. The truth of this axiom may be seen from an examination of the analyses given in Table 5. These are made on two areas that have been top-dressed twice, using 3 cwt. basic slag per acre each time. Analyses 1, 2, and 3 are on a danthonia-dominant sward which has been derived largely by constant crushing during the early years of the breaking-in of this country. Analyses 4, 5, and 6 are taken on a weak, worn-out pasture remnant of the old sown turf, but where apparently depletion of fertility had not gone so far as in the case of the danthonia-dominant sward; this state is indicated by the percentage of the better elements showing in the pasture, as seen in analysis No. 4, done prior to the first application of manure. On each of these two areas approximately £2 per acre has been spent, and if one takes the clover increase as representing the major response of the top-dressing it will be seen that in the one case this has increased by 24 points in two years, and in the other case the increase has been 76 points, or approximately a response three times greater. In the one case it took two applications to get 23 points of suckling-clover, and in the other only one application to get the same response. In the case of white clover it would appear that two applications of manure on the danthonia-dominant area were required to bring this up to the state of the second area before any manure was applied. The two applications on the second area increased the white clover by 55 points. As far as the other constituents of the sward are concerned, apart from a general

toning-up reflected in the much greater palatability of the pasture, there seems to have been little change up to the present. Just what effect this vigorous growth will have on the other species is a matter for further study.

(7) Crushing followed by Seeding.

Does it pay to spend money on seed in the effort to thicken up weak, old turfs? The thickening-up of weak turfs—that are so characteristic of country newly crushed out of secondary growth, and of old worn-out pastures where unsuitable species have been sown — by the surface-sowing of more seed of grasses and clovers has been tested fairly extensively at Whangamomona, and almost without exception it can be said that the sowings have been an utter failure. In my opinion no money should ever be spent in surface-sowing on weak turf—at any rate not by the impecunious who need rapid return for money expended—unless the surface can be stirred to some extent and liberally top-dressed with artificial manure.

One application of manure on the general run of hill-country turf is of little value in aiding establishment, and by the time two or three applications have been made the growth of suckling-clover and other such plants has so increased as to cover the ground, which again adds to the difficulty of any other seed establishing itself.

On any area of weak turf sown one can find odd plants of paspalum, crested dogstail, subterranean clover, brown-top, rye-grass, and danthonia; but the general effect of these, for the first three years at least, in thickening up the turf is virtually nil, and the practice must be considered uneconomical. In examining the turfs in a general way one would say that crested dogstail was about the best establisher in weak, open ones, but, as will be seen from the analyses given in Table 6, very little added cover has been secured from a very heavy experimental sowing of this seed.

Table 6.—Showing attempted Introduction of Crested Dogstail into a Weak Turf by Surface-sowing of Seed.

Crested dogstail sown 1926 at the rate of 20 lb of seed per acre. Analyses made four months after seeding.

Species recorded.	Plot 1. Not top-dressed at Time of Seeding.	Plot 2. Top-dressed with 1 cwt. Super. at Time of Seeding.
Bare ground	13 per cent.	19 per cent.
Crested dogstail	0·4 points	..
Brown-top	19 ,,	7 points
Cocksfoot	18 ,,	18 ,,
Danthonia pilosa	13 ,,	20 ,,
Yorkshire fog	19 ,,	21 ,,
Perennial rye-grass	6 ,,	7 ,,
Catsear	6 ,,	6 ,,
Poa pratensis	4 ,,	7 ,,
Piripiri	7 ,,	1 ,,
Hawkweed	7 ,,	5 ,,
Other grasses	1 ,,	0 ,,
Suckling-clover	0·4 ,,	0 ,,
Other weeds	10 ,,	11 ,,

This is a record of establishment only, and it will be seen that on the old turf crested dogstail has completely failed. In one-, two-, and three-year-old surface-sowings of weak turfs there has been virtually no improvement effected. For the time being, at any rate, no money should be spent on seed for the thickening-up of weak, worn-out turfs, nor for turfs formed after the crushing-out of secondary growth. The one golden opportunity of getting a good sward established satisfactorily lies in the ash of the burn.

(8) Top-dressing without Burning or Seeding.

It is claimed that such top-dressing renders what feed there is within or immediately surrounding the secondary growth so much more plentiful and palatable that stock are drawn on to the top-dressed portions and held there in sufficient numbers to control the secondary growth without recourse to the force that is implied and applied in the crush method.

Where there is weak secondary growth with a fair amount of grass persisting among it, and where it is impossible to get a fire to travel through the growth, then the application of manurial top-dressing may be perfectly sound; but to top-dress any sort of dense secondary growth is, in my opinion, absolutely futile and an economic waste. Particularly is this true of dense bracken fern, hard fern, or manuka, and other scrub that has been felled and not burnt. Top-dressing grassed portions between masses of this growth may be perfectly sound, but to give the secondary-growth patches a double dose, as is so often done, is, in my opinion, foolish. In this experimental work I have studied patches of hard fern, &c., that have had two and three applications of manure, and by no stretch of imagination could one say that from £2 to £3 an acre improvement had been effected. Grassed patches between clumps of secondary growth were certainly showing a marked improvement from the top-dressing, but not so the hard fern and other secondary growth itself. It must be remembered that in top-dressing one is spending hard cash, and to throw that away indiscriminately is economic suicide. If a farmer is in a position to top-dress a paddock he should first burn and sow these clumps of secondary growth, and then every pound of manure applied will have some useful vegetation to feed.

Conclusion.

I have here endeavoured to outline and to show by carefully made analyses the general trend of the development of this experimental work and some tentative conclusions regarding it. The measuring of results of experimental sowings, top-dressing trials, &c., and the weighing-up of all the factors operative in the developmental phases connected with the regrassing of the deteriorated country must necessarily take time. I feel confident, however, that by carefully recording, year by year, each step in that development—be it retrograde or forward—ultimately it will be lack of application rather than lack of knowledge if the country is not successfully and economically grassed.

My thanks are due to the Director of the Fields Division, Mr. A. H. Cockayne, for guidance in this work generally. Credit in connection with the botanical point analyses accompanying this article is freely given to my assistant, Mr. E. A. Madden.

THE BLACKBERRY PEST.

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I. BIOLOGY OF THE PLANT.

BLACKBERRY is a member of the family Rosaceae, which includes one hundred genera and two thousand species, to which belong most of our fruits of economic importance. Blackberry itself belongs to the genus *Rubus*, a cosmopolitan genus comprising two hundred and twenty-five species, occurring most abundantly in the North Temperate Zone. In the British Isles alone there are over forty species and varieties of this genus; New Zealand has only four native species and three varieties, making a total of seven. Belonging to the same genus and closely allied to blackberry are loganberry, raspberry, &c.

FIG. 1. RUBUS FRUTICOSUS LINN.

[*Photo by H. Drake*

INTRODUCED SPECIES.

Into New Zealand there have been introduced two main types of blackberry -namely, *Rubus fruticosus* Linn. and *Rubus laciniatus* Willd. The first (Figs. 1 and 2) is a very variable plant, and is found growing abundantly in many parts of New Zealand, having been originally introduced by the early missionaries. The second (Fig. 3) is not nearly so widespread; it is most abundant in the Wellington and Wairarapa districts, though also occurring in Manawatu and Taranaki, and to a less extent in Auckland and Poverty Bay; but nowhere is it as abundant as *R. fruticosus*.

The size and the extent of the bushes vary very considerably in different districts throughout New Zealand, and in different situations

FIG. 2. PORTION OF FRUITING BUSH OF RUBUS FRUTICOSUS.

FIG. 3. RUBUS LACINIATUS WILLD.

[*Photos by E. F. Northcroft.*

in the same district. Even on the same hillside local variations very considerable in extent occur. One large bush, unfortunately, is not the result of growth from a single crown which becomes larger the older the bush becomes; it is made up of several large crowns and very many small ones, together with numerous rooted stems. This condition, besides more than doubling the labour required to clear the land by the usual method of cutting the plant, makes the problem of treatment in any experimental work towards eradication or control far more difficult. (Fig. 4.)

MEANS OF DISTRIBUTION.

Flowers are produced terminally on the long main shoots, or on the short lateral shoots, in very great abundance. Flowering takes place towards the end of November or the beginning of December, the fruit being ripe about the beginning of March; but these times vary considerably each year in different localities. The several means of distribution of the plant are as follows:—

(1) Seed.

The edibility of the fruit is the main cause of the great and wide spread of the weed throughout the country. The fresh seed (Fig. 5) does not germinate readily, but it has much greater powers of germination after being acted upon by the gastric juices. Birds are the principal agents in this case, though it is very noticeable how abundant the plant has become round old camps and along roadsides where gangs of roadmen have been employed. However, there is no doubt that birds are responsible for the spread of the weed in the hill country of New Zealand, and also for its frequent appearance immediately after a good bush-fire. It is quite a usual thing to find a number of young plants growing in the tops of old stumps, or even high up in the fork of a tree, where there is any decaying matter. Birds must have deposited the seed in such situations. Also there is no doubt that the frequent occurrence of blackberry-bushes along so many of our fence-lines while the land on either side is clear is due to carriage by birds.

(2) Rooting-stems.

Another method of spread is by means of rooting-stems, which are produced by the parent bush. Towards the end of summer many of the long vines which were produced in the spring commence to grow downwards, becoming greatly elongated. Tracing these stems from the bush towards the growing point it is seen that there is a very noticeable reduction in size and change in form of the leaves, which gradually become more and more reduced until ultimately they become represented by scales. Morphologically these stems represent greatly elongated growing-regions. Other long shoots, which commence their development in the late summer, come from the centre of the bush and grow out along the ground. These in appearance are exactly the same as those already described. The ends of these shoots either lie closely appressed to the surface of the ground, or, where the soil is soft and damp, they penetrate to a very slight extent. On touching the soil the tip swells slightly, and strong rootlets, which soon fix the end firmly in the soil, are developed in great numbers. For some time there is no appearance of any shoot, but the great development of root takes place just a short distance back from the growing point.

FIG. 4. TYPICAL BLACKBERRY-BUSH IN INFESTED COUNTRY.
[*Photo by E. F. Northcroft.*

FIG. 5. SEEDS OF BLACKBERRY (RUBUS FRUTICOSUS). × 20.
[*Photo by H. Drake.*

FIG. 6. ROOTING-STEM OF BLACKBERRY, WITH TERMINAL (ON RIGHT) COMMENCING TO ELONGATE.

FIG. 7. ROOTING-STEM OF RUBUS LACINIATUS (AT FOOT OF PHOTO).
Also shows gradual reduction of leaves to scales as stem elongates.
[*Photos by E. F. Northcroft.*

FIG. 8. ROOTING-REGION OF RUBUS LACINIATUS. ENLARGED.
[*Photo by E. F. Northcroft.*

Fig. 6 shows a specimen of *Rubus fruticosus* with the shoot just beginning to elongate. Figs. 7 and 8 show the same condition in *R. laciniatus*, but here the shoot has not commenced to grow out (Fig. 8), while the reduction of the leaves to scales is clearly seen in Fig. 7. When the end has become firmly established the tip continues its growth, and a strong shoot is soon developed (Fig. 9). In most cases shoots of this type are abundant round all the bushes, and in this way it is very easy to explain the rapid spread of the weed on a place where only a few plants had originally established themselves. I have frequently measured runners of this type growing in many cases up to 20 ft. long in a single season. Lateral branches of the same form as the parent frequently develop from the leaf-axils of these rooting-stems, and each of these branchlets may become rooted in the manner described; hence in a very short time the bush becomes surrounded by a tangled mass of firmly rooted runners. Fig. 10 shows the end shoots of a single runner of *R. fruticosus* where all the tips had commenced to penetrate the soil preparatory to the development of the adventitious roots.

(3) Cuttings.

Besides the spread of blackberry by seeds and rooting-stems there is the agency of man by cuttings. Throughout the country there are many creeks and rivers with their banks covered by a dense mass of blackberry. By law the weed has to be cleared once a year, and where the banks are not too steep the usual method is to cut down the growth. The cut material is as a rule left, and a great many pieces are allowed to fall or are pushed into the water. Generally no burning is done, but the debris is left for floods to wash away and so clear the upper parts of the watercourse. The result is that large numbers of cuttings

FIG. 9. WELL-DEVELOPED SHOOT OF RUBUS FRUTICOSUS (ON LEFT) AFTER ELONGATION.

FIG. 10. ROOTING MAIN SHOOT AND LATERALS OF RUBUS FRUTICOSUS.

[Photos by E. F. Northcroft.

are spread along the banks from the original bushes to the sea, and frequently over the flats is found a crop of young blackberry-cuttings after the flood-waters have receded. These cuttings strike with great readiness, and thus in a very short space of time large areas of flat land and many shallow shingly river-beds are badly infested. These river-bed blackberry-plants are in their turn left to flourish and produce an abundance of seed for the birds to scatter.

CROWN AND ROOTS.

The vines of the blackberry spring from a crown (Fig. 11), which in old bushes very often becomes as much as 6 in. in diameter. From below are given off numerous large, long, stout roots, which travel in all directions and for very great distances. I have traced a number

FIG. 11. BLACKBERRY CROWN, 4 IN. IN DIAMETER.

[Photo by E. F. Northcroft.

out; the longest, which did not go more than 3 ft. deep, was traced for a distance of 34 ft., and where it broke off was $\frac{1}{4}$ in. in diameter. Generally, however, the main root descends vertically from the crown, penetrating to a great depth, and it is only the secondary roots which seem to travel more or less horizontally; but the general habit of even these secondary roots is to travel horizontally for a few feet and then descend to great depths.

Fig. 12 shows another crown of *Rubus fruticosus*, this being 4 in. in diameter. The main root of this crown I traced to a depth of between 5 ft. and 6 ft., and it was not until it had reached a depth of about 2 ft. that laterals of any size were given off. Frequently lateral roots after penetrating vertically for a foot or two grow horizontally for a time, and stems are often produced from these. Fig. 13 illustrates

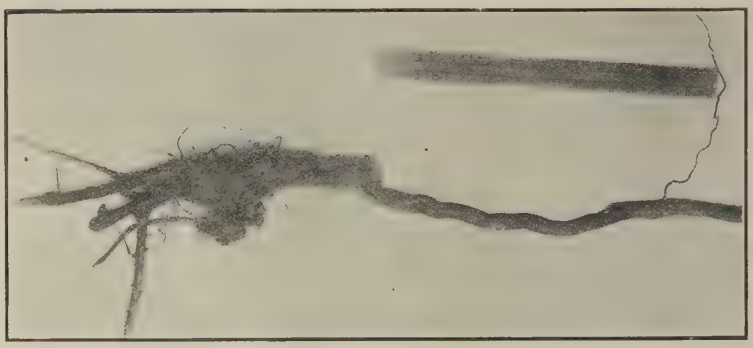

FIG. 12. SMALL CROWN AND MAIN ROOT OF RUBUS FRUTICOSUS.
[*Photo by H. Drake.*

NOTE.—This photo should be viewed vertically from the right-hand side.

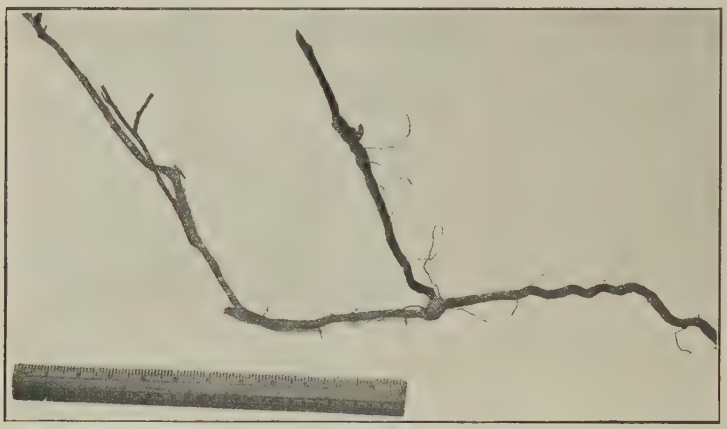

FIG. 13. ROOT OF RUBUS FRUTICOSUS GIVING RISE TO TWO AERIAL SHOOTS.
[*Photo by E. F. Northcroft.*

a case where two shoots were produced from a lateral root. This root had penetrated to a depth of 15 in., then, running horizontally, had come closer to the surface, and when 6 in. deep the shoots had developed. On following this root farther it was found to take a much more vertical course. Fig. 14 shows a shoot developed from a secondary root 18 in. below the surface.

The roots have very great vitality, and can remain dormant for long periods if conditions are not favourable for the production of aerial shoots. If the tops are cut down to the crown, or even burnt, it is

only a matter of a very few weeks before shoots are appearing from the crown (Fig. 11). If the crown is carefully cut off, then shoots soon develop from just below it, or even all along the main axis right down to a depth of 15 in. (Figs. 15 and 16). A root cut back to a depth of 18 in. and showing a strong development of shoots is seen in Fig. 17, and there is every reason to believe that shoots would develop at even greater depths than this. A root which through river erosion, slips, or other causes becomes exposed, immediately throws out numerous green leafy shoots in great abundance all along the exposed portion. I have often seen roots exposed on a cutting and for a distance of 20 ft. from the crowns becoming covered with leafy shoots.

FIG. 14. SHOOT (*a*) DEVELOPED FROM A SECONDARY ROOT OF RUBUS FRUTICOSUS 18 IN. BELOW THE SURFACE.

[Photo by E. F. Northcroft.

SEEDLINGS.

The seedlings of *Rubus laciniatus* and *R. fruticosus* are quite distinct from the time of the appearance of the first leaf. Young plants of the former are shown in Fig. 18, and one of the latter in Fig. 19. Both species take a long time to germinate and then to establish themselves. The seeds may lie in the soil a year or fifteen months before they show any visible signs of life. As soon as they germinate they very quickly reach the stage shown in Figs. 18 and 19. Then they remain apparently stationary for a very long time, during which an abundance of root is produced. I have found in many cases the length of the root of the seedling to exceed that of the aerial part by about ten times. One seedling had an aerial part 6 in. high, while the root had travelled vertically down for a distance of 3 ft. 4 in.

GERMINATION.

As indicated, the powers of germination of blackberry-seed are surprisingly poor. Experiments have been carried out with—(1) Fully developed seeds from green fruit; (2) seeds from ripe fruit; (3) badly charred seeds collected after the land had been swept by fire; (4) slightly charred seeds from the same burnt area; (5) seeds passed through birds; (6) seeds from blackberry and apple jam.

In these germination experiments several thousand seeds were tested in germinators—using fully formed seeds from green fruit, seeds

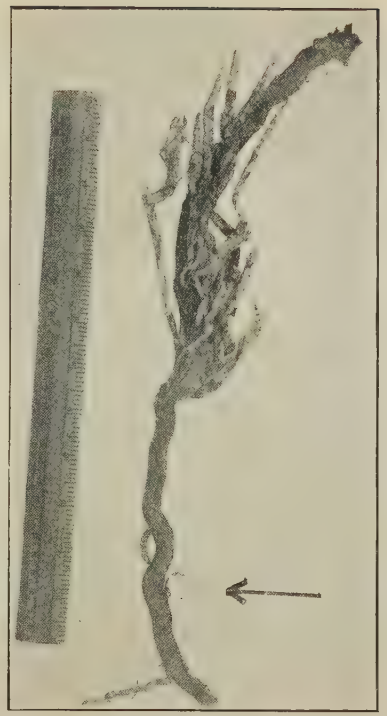

FIG. 15. SHOOT-DEVELOPMENT ON RUBUS FRUTICOSUS DOWN TO A DEPTH OF 15 IN. AFTER THE CROWN HAD BEEN COMPLETELY REMOVED.

FIG. 16. SHOOTS DEVELOPING ON RUBUS FRUTICOSUS JUST BELOW THE CROWN, WHICH HAD BEEN CUT OFF.

FIG. 17. SHOOTS OF RUBUS FRUTICOSUS DEVELOPING FROM THE ROOT AFTER CROWN AND ROOT HAD BEEN REMOVED TO A DEPTH OF 18 IN.

[*Photos by E. F. Northcroft*

from ripe fruit, and seeds from the various jams—without any sign of germination. In a greenhouse the six sets of seeds enumerated in the last paragraph were sown in ordinary garden soil, and germinations took place only in the case of—(1) Fully formed seeds from

FIG. 18. SEEDLINGS OF RUBUS LACINIATUS.

[*Photo by E. F. Northcroft.*

green fruit; (2) seeds from ripe fruit; and (5) seeds passed through birds. In the two first cases thirteen months passed before there was any sign of germination, and at the end of two years (1) had shown only 4·1 per cent. germination and (2) only 7·3 per cent. In the case of (5), berries of *Rubus fruticosus* and *R. laciniatus* were fed to fowls, and there was no sign of germination till fourteen months. From *R. fruticosus* the percentage germination was 16·7, and from *R. laciniatus* 28·1.

FIG. 19. SEEDLING OF RUBUS FRUTICOSUS.
[*Photo by E. F. Northcroft.*

In the case of (6), seeds were used from various brands of bought jam, and also from home-made jam; but in two years there was no sign of any germination. A year ago a further series of jams containing blackberry were procured and tested, but without result. This fact is interesting as well as instructive, as it has been several times emphatically declared that seeds from commercial jam will germinate.

(To be continued.)

WOOL-IMPROVEMENT.

At the meeting of the Board of Agriculture held last month the President reported that he had received a number of replies to a circular memorandum on the question of wool-deterioration, but that sufficient information was not yet available to warrant the Board issuing a report on the subject. A number of samples of wool were submitted and examined by members, and the matter was discussed at some length. It was decided that further steps should be taken to educate farmers in the best methods of wool-growing and in the selection of their breeding-sheep. To this end the Board considered that the Council of the New Zealand College of Agriculture should appoint a lecturer on the subject and make wool a special feature in the training of students attending the college, and that in the meantime the valuable educational work now in the hands of the Department of Agriculture and Mr. W. Perry should be continued and extended as far as circumstances would permit.

Noxious-weeds Order.—The Upper Hutt Borough Council has declared broom, fennel, foxglove, gorse, lupin, ox-eye daisy, pennyroyal, periwinkle, St. John's wort, tauhinu, tutsan, and goat's-rue to be noxious weeds within that borough.

LIMING OF PASTURES.

INITIAL RESULTS OF EXPERIMENTS IN AUCKLAND.

T. H. PATTERSON, H.D.A., Instructor in Agriculture, and J. W. WOODCOCK, N.D.A., Assistant Instructor in Agriculture, Auckland.

LIMING is a very old-established practice in British farming, and, as was only to be expected, considerable attention has been given to it in New Zealand. The application of lime to the soil on New Zealand farms, however, is not so widely practised.

In certain districts in the Auckland Province liming pastures and soil for cropping is regarded as a valuable aid in maintaining fertility, and lime is used almost wholly in the form of ground limestone rock, which contains about 90 per cent. of calcium carbonate, its price ranging from about 18s. to 20s. per ton. Where cartage from the railway-station or the shipping-point is not more than about ten miles, lime is regarded by those who use it as an economic soil-improver. How far this opinion is based on sound foundations is difficult to judge. It seems opportune at this juncture, therefore, to examine some of the probable reasons why liming is practised in some districts, but, generally speaking, is rather neglected.

Farmers who do not lime say that it does not pay. Farmers who practise the liming of pastures contend that the colour of the grass is better and clover more abundant; that stock like the pasture better, and that the health of the animals is improved. Liming increases the value of superphosphate: there is a good deal of evidence in support of this. Those, on the other hand, who do not favour lime say that they see no improvement, or, if improvement is admitted, that the same amount of money spent in additional fertilizer dressings (usually phosphatic) pays better. In the case of leguminous crops such as lucerne, peas, &c., farmers generally admit that it pays to lime.

BRIEF GENERAL REVIEW.

The beneficial practice of liming in British agriculture has been widely known in New Zealand, and doubtless has had a far-reaching influence. The success of liming at Edendale, in Southland, where it was first practised on a considerable scale in 1890, drew attention to its undoubted value on Southland soils, and compelled farmers in other parts of New Zealand to consider lime and its use.

Liming experiments conducted by the Department of Agriculture in New Zealand, and recorded in this *Journal* since 1911, show divergent results. At Ruakura Farm of Instruction (June, 1911) oats on light partially drained peat swamp gave no favourable response to amounts of ground limestone ranging from 5 cwt. to 1 ton per acre; oats, however, cannot be regarded as a good indicator crop for testing lime. A catch-crop of peas, oats, and barley followed, with luxuriant growth declining with reduction in the quantity of lime applied.

McTaggart reported tests on pasture on the foothills and the plains of Canterbury, with dressings of ½ ton and 1 ton of burnt lime per acre and double those rates of ground limestone, during 1915–16. On

visual evidence good results were recorded on the limed areas, though the season was dry.

Greenwood's trials at Martinborough, Wairarapa, in 1921 showed increased yields of rape to the extent of 75 per cent. over the control areas. In this case heavy dressings of lime were used in addition to the ordinary rape fertilizers employed. The second season's results (without further liming) with grass and rape gave increased yields to the extent of 46 per cent.

In 1921 Patterson reported that burnt lime at the rate of 68 lb. per acre, applied when sowing down permanent pasture on heavy loam at Motuihi Island, depressed the yield of hay cut the same season.

Dalgliesh reported favourably in 1923 24 on the use of lime on the light soils of the Waimaunga Experimental Farm, Westland. Pastures, root, and other crops benefited. The heavier soils of the West Coast also showed a good response to lime.

McGillivray recorded in 1924–25 good results with heavy dressings of lime on temporary pasture at Winton Experimental Area, Southland, the clover content being greater on the areas receiving ground limestone than with burnt lime.

Greenwood reported two trials in Marlborough in 1925 on permanent pastures, where lime used with superphosphate showed to advantage when compared with super alone.

Instances may be quoted in Auckland Province. At Albany and Puwera, on heavy gum-lands, burnt lime lightened the sticky clay and made it more friable. Ground limestone used with ground rock phosphate in sowing grass depressed the yield. On pasture top-dressing trials at Te Kumi, where super and ground rock phosphate (Nauru) each were used every year for six successive years, Patterson reported that the yield of hay from the limed areas was lower than from the unlimed, but the quality, judged by the increased clover content and lower percentage of weeds, was better from the limed plots. The differences in weight yield of hay were not statistically significant. Observations over the period of six years showed that the effects of a 1-ton dressing of ground limestone did not show up so markedly in the first as in subsequent seasons.

In the last April issue of the *Journal* Hudson reported carefully planned and examined Canterbury trials with 1 ton of ground limestone as a top-dressing on pasture, applied in 1924 in most cases, and manured with phosphatic fertilizers. Lime gave varied results as judged by the comparison in the weight of hay harvested. He regards his conclusions so far as tentative, awaiting further data from extended trials.

Most of the trials cited in the review just given were not planned with the idea of subjecting the results to the severe scrutiny of the most modern methods of field experimentation, nor would they probably stand such a test. Hence the results given in such cases and the observations made by the respective experimenters should be accepted only on this understanding. The results, nevertheless, are full of interest to those desirous of getting at the pros and cons of liming.

Mr. B. C. Aston, Chemist to the Department of Agriculture, has for many years past drawn attention to the agricultural value of lime, and has published chemical analyses of soil-samples widely drawn, which indicate in the Auckland Province and elsewhere a high lime-requirement.

The Present Auckland Experiments.

With the object of further testing the value of lime, experiments were started in Auckland Province last year. It is intended to continue these trials, and to extend the number, with the object of ascertaining whether lime is economically valuable on pastures with and without the ordinary fertilizers.

The success which has attended the top-dressing of grassland with phosphates during the last few years has resulted in a great increase in this practice. Many farmers in Auckland Province who only a few years ago applied an annual dressing of 2 cwt. per acre are now putting on up to 5 cwt. and 6 cwt. each year, while in a few instances 10 cwt. per acre is applied. There is no doubt that on these heavily top-dressed soils far more phosphate is being added than is removed by crops and stock, and as phosphate is not removed by drainage there must be good reserves accumulated in the soil. These phosphatic reserves may exist in different forms according to the nature of the soil constituents; yet even in such cases top-dressing is necessary each year, since the store of phosphate in the soil is apparently unavailable. This is especially liable to occur when a water-soluble phosphate is applied to a soil deficient in lime. The phosphate is precipitated in the soil, and if there is no calcium with which to combine it will probably unite with the bases aluminium or iron, forming combinations regarded as not so readily available.

An experiment was commenced in 1926 at two centres in Auckland Province to ascertain whether such soils, which had been heavily phosphated in the past, would yield some of their wasted phosphate fertility when treated with lime in one of its forms.

Plots were treated with the following dressings per acre: (1) 3 cwt. superphosphate, 44/46 per cent. grade; (2) 2 tons ground limestone (Te Kuiti); (3) 1 ton burnt rock lime. A fourth plot was left unmanured as a check.

The plots were laid down the width of the manure-drill (8 ft. wide) across the field for a distance of 6 chains, and alternated in such a way that each plot could be compared with a plot of different treatment adjacent. There were six series, giving twenty-five strips in all, and allowing twenty-four comparisons between each treatment. Six areas, each $\frac{1}{165}$ of an acre, were taken on each plot. The method of cutting and weighing was similar to that employed by the Fields Division in Canterbury, as described in the *Journal* for June, 1925, the grass being weighed green in the swath as soon as mown. In order to express the results in a convenient form so that the financial aspect may be reviewed, the weight of green material is here expressed as hay. For this purpose the hay weight is regarded as being one-third of the green weight, and the value of 1 ton of hay can be reckoned as £5.

FARM OF J. SUTHERLAND, KIHIKIHI, WAIKATO.

The soil on this area is a residual volcanic, being a heavy loam moderately supplied with humus. The pasture was laid down twelve years ago, and has since received annual dressings of superphosphate or basic slag, 2 3 cwt. per acre. During the past four years two dressings per year have been applied. In the early autumn of 1926 the dressing

was varied, and consisted of a mixture of equal parts bonedust, superphosphate, and sulphate of potash. The field has been cut for ensilage for several years. The plots were treated on 13th September, 1926, and the field was closed during the second week in October. On 7th December it was cut for ensilage and the plots were weighed.

The weight factor as an indication of improvement: An increase in weight on a plot treated with phosphate or lime over an untreated plot can always be reckoned as an indication of improvement. It is realized that herbage from a plot so treated is superior in feeding-quality to unmanured grass, and therefore a weight increase must be a criterion when the increase is in response to manurial treatment. When two manurial treatments are compared the superiority of one over the other as shown by weight increase is not so evident. Since, however, the object of the present experiment was to release phosphate and make it available to the plant on the one hand, and to apply available phosphate on the other, we assume that any increase in weight of herbage is mainly due to such causes. During the growth period there was no visible difference between the plots, but a few weeks after cutting there was a striking contrast, as will be described later.

Table 1.

Treatment Comparison, A *versus* B.	Weight expressed as Tons of Hay per Acre.		Difference: Significant (S.) or Not Significant (N.S.).
	Yield.	Difference in Favour of A.	
A. Super	3·356	0·381	S.
B. Control	2·975		
A. Lime carbonate	3·125	0·334	S.
B. Control	2·791		
A. Control	2·572	0·081	N.S.
B. Burnt lime	2·491		
A. Super	3·150	0·353	S.
B. Lime carbonate	2·797		
A. Super	3·231	0·451	S.
B. Burnt lime	2·780		
A. Lime carbonate	3·086	0·366	S.
B. Burnt lime	2·720		

NOTE.—Difference not significant when chances in favour of treatment are less than 30 to 1.

Comments on Table 1.—Treatment *versus* no manure: Both super and carbonate of lime have given significant increases over no manure, but, whereas the application of superphosphate has given a profit of approximately £1 1s. in the first year, there has been a loss in the case of the carbonate. An application of 2 tons in one year, especially as the crop was cut within four months of treatment, could scarcely be expected to pay for such application in the first year. As it is, the results from carbonate of lime are highly satisfactory. Burnt lime has caused a depression when compared with the natural yield, but this difference is not significant.

Super *versus* lime: When super is compared with carbonate, the former shows its superiority by a difference of 0·353 ton per acre. While one cannot generalize in such a short time, it would appear from the first year's figures that even when previous history, supported by chemical analysis of the soil, indicates a sufficiency of phosphate the application of a suitable phosphatic top-dressing is a payable proposition. Superphosphate gives a great increase over burnt lime, which has given poor results so far in this experiment during the period under review.

Examination of the aftermath: An inspection of the plots a month after cutting showed that the super and carbonate plots stood out clearly from the others by reason of the fine growth of perennial rye-grass. The control and burnt-lime plots showed little growth of rye-grass, and appeared a flowery mass of catsear and hawkbit Although a certain amount of each of these weeds appeared in the super and carbonate-of-lime plots, yet only a small proportion was present as compared with the others.

FARM OF B. J. ROULSTON, PUKEKOHE.

The soil here is a medium chocolate volcanic loam, typical of much land in the dairying district round Pukekohe. The pasture, consisting of good-quality grasses, chiefly rye-grass and meadow-foxtail, was laid down in 1915. For seven years it was top-dressed annually with 2 cwt. of either basic slag or superphosphate, chiefly the former. Four years ago 3 cwt. basic slag was applied, and this was followed with a mixture of 3 cwt. super and guano for two years. The plots were treated on 30th August, 1926, and the field was closed for hay in early October. On 11th December it was cut and the plots weighed. At no time during the growth period was any difference noted.

Table 2.

Treatment Comparison, A *versus* B.	Weight expressed as Tons of Hay per Acre.		Difference: Significant (S.) or Not Significant (N.S.).
	Yield.	Difference in Favour of A.	
A. Super	3·037	0·062	N.S.
B. Check	2·975		
A. Check	2·675	0·022	N.S.
B. Lime carbonate	2·653		
A. Burnt lime	2·901	0·025	N.S.
B. Check	2·876		
A. Super	2·996	0·052	N.S.
B. Lime carbonate	2·944		
A. Super	2·876	0·176	S.
B. Burnt lime	2·700		
A. Burnt lime	2·913	0·012	N.S.
B. Lime carbonate	2·901		

Comments on Table 2. — The only significant difference is that between super and burnt lime, the other comparisons not being measurable with certainty. Even super has given no significant increase over no manure. When the aftermath was examined one month after cutting there was no visible difference between any of the plots.

RELATION OF RESULTS TO CHEMICAL ANALYSIS.

According to chemical analyses made at the Department's Laboratory the Kihikihi soil, although slightly deficient in available phosphate, is correspondingly well supplied with total phosphate. The Pukekohe soil in comparison is poorly supplied. Both soils are deficient in lime. Details are given in the following table :—

Table 3.

Percentages on Top Soil dried at 100° C.

	Kihikihi Soil.	Pukekohe Soil.
Total phosphoric acid	0·18 per cent. ..	0·09 per cent.
Available phosphoric acid	0·009 per cent...	0·002 per cent.
Lime-requirement (Hutchinson and McLennan method)	4·8 tons per acre	3·4 tons per acre.

One can hardly explain why after ten years' continuous top-dressing the phosphate deficiency should be so high on the Pukekohe soil. It is a well-known fact that this is a type of soil particularly responsive and liberal, otherwise it would not be valued so highly. Economic conditions on such high-priced land force high production and intensive farming methods. The field was only 2 acres in extent, and has been heavily stocked. But we have here two soils, one with a much higher phosphate content than the other. When a heavy dressing of carbonate of lime is applied to the Kihikihi soil there is an immediate response, but such treatment has had no effect on the Pukekohe soil. Yet superphosphate has only given an immediate result in one case, and that on the soil with the higher phosphate content. This probably serves to show the limitations of soil analysis without support of field evidence. Superphosphate was used in these experiments not because it was thought to be the best type of phosphate to use in each case, but to obtain uniformity. Field experiments conducted in the Pukekohe district over a number of years seem to indicate that basic slag and rock phosphate give better results than super, probably on account of the high iron-content of the soil. Farm practice in this district also supports that view, and when super is applied it is almost invariably mixed with lime ; but basic slag and basic super are more favoured.

CONCLUSION.

In conclusion, it must be remembered that these results were obtained within four months of treatment. Therefore one cannot draw too definite conclusions regarding the failure of any one treatment. An immediate response is expected in the case of superphosphate, but the effect of lime is often belated. After two or three years' results have been obtained, together with repeated observations regarding the nature of the herbage, we shall probably be able to make definite assertions as to whether heavy dressings of lime are economical.

We tender our thanks to Mr. Sutherland and Mr. Roulston, who co-operated with the Department ; also to Mr. G. Wild and other officers of the Fields Division, who took part in the experimental work

THE EUROPEAN EARWIG: ITS HABITS AND CONTROL.

SOME RECENT EXPERIMENTAL WORK IN NEW ZEALAND.

J. MUGGERIDGE, Biological Laboratory, Wellington.

EARWIGS are readily recognized by their characteristic wings and forceps. The forewings are small leathery coverings which extend a short way along the back, while the hindwings are large and when not in use are compactly folded beneath the forewings. All earwigs have forceps or "pincers"; these arise from the posterior end of the body, and vary in shape according to sex.

According to Fulton the name "earwig" originated in the Anglo-Saxon word earwicya, meaning "ear-creature." He states that the name has the same significance in nearly all European languages, point-

FIG. 1. MALE EUROPEAN EARWIG. × 6.
[*Photo by H. Drake.*

ing to the widespread belief that earwigs crawl into the ears of sleeping persons. There are, however, no grounds to substantiate any such belief, except that the earwig will go into any crevice for shelter during the day, like any other nocturnal insect.

In New Zealand earwigs are poorly represented among the native insects, and none is injurious. The species so prevalent and injurious in the Dominion, especially in the South Island, is the European earwig (*Forficula auricularia* Linn.). The adult measures from $\frac{5}{8}$ in. to $\frac{3}{4}$ in. long; the forceps of the male (Fig. 1) are stout and strongly curved, while those of the female (Fig. 2) are comparatively straight. The general colour of the insect is dark or reddish brown, though occasionally a whitish one occurs. In the case of the latter the skin has just been shed and the permanent dark colour has not yet developed.

During the last few years the European earwig has become a pest of considerable economic importance to both town and country dwellers, but more especially to fruitgrowers.

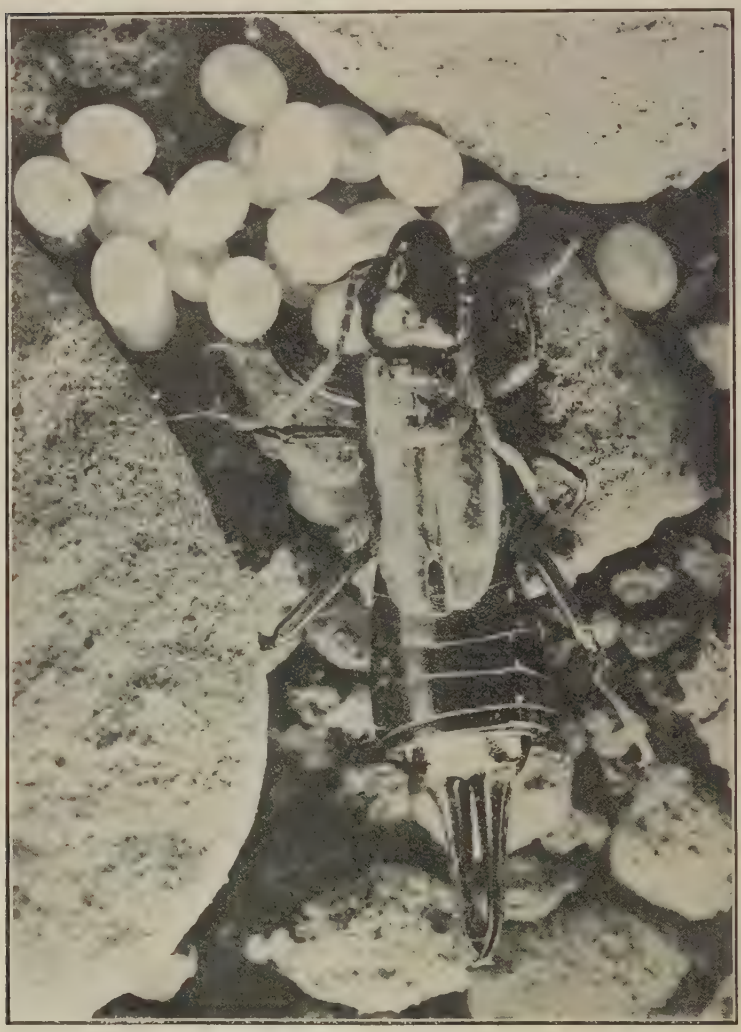

FIG. 2. HIBERNATING FEMALE EARWIG, WITH EGGS. GREATLY ENLARGED.

[*Photo by H. Drake.*

Life-history and Habits.

Mr. D. Miller has studied the life-history of the insect in New Zealand, and has found it to differ but little from what takes place in other countries.

The winter is passed in the adult and egg stages underground, or in some other suitably moist and sheltered place. Both sexes hibernate, but the female lies with her batch of eggs laid in the ground (Fig. 2). If by any chance the eggs are scattered the female will gather them together, carrying one at a time in her jaws.

During August and early September, as a rule, the eggs hatch and the minute white earwigs swarm in the ground (Fig. 3 *a*). Earwigs are nocturnal, and on the first night after hatching the young insects leave the ground and feed upon the tender parts of plants. They eat out small holes on young leaves (Fig. 4), or feed upon the pollen, stamens, &c., of flowers. As the insect grows to the adult form it sheds its skin four times as a rule, and after each moult the developing wings become more conspicuous (Fig. 3 *a–d*). Maturity is reached about November and December, and it is at that time or a little earlier that the earwigs attract attention, since in the younger stages they are much less conspicuous. The hibernating males and females live for some time after emerging from hibernation, and frequently mate in September or October, when a second batch of eggs is laid by the female, after which these adults die. Therefore individuals of various ages from the early and late spring broods are found at the same time.

Earwigs do not confine their depredations to the open, but make themselves particularly disliked through their habit of invading dwellings. At night-time they come out of their places of concealment in search of food, and at daylight seek shelter again under boards or pieces of sacking and the like. This habit provides one means of control, as will be mentioned later. Their food range is very extensive, including practically anything that may be considered edible: even cannibalism is resorted to in some instances. It is stated that the earwig is an enemy of codlin-moth. This may be so, but it was noticeable during the past season that in some parts where heaviest earwig infestation occurred the codlin-moth was also very prevalent -- indeed, worse than for several years. Thus, even if the earwig is an enemy to the moth larva, its economic value as a controllant is not to be relied upon.

As already indicated, owing to the infestation of fruit the earwig has become a significant economic pest to the orchardist, the types of injury being such as to depreciate considerably the market value of this commodity. One of the worst features is the fact that the insect is able to conceal itself within the fruit.

Control Measures.

A great deal of work has already been done on earwig control—both biological and chemical—in other parts of the world, notably from the chemical aspect by Fulton.*

The present discussion deals mainly with poison-bait control, and but little with natural enemies. Among the latter are birds, insects,

* Fulton, B. B.: The European Earwig. *Oregon Agricultural College Bulletin 207.*

FIG. 3. PRE-ADULT STAGES OF EARWIG.
(*a*) Newly hatched; (*d*) immediately before adult.

and perhaps hedgehogs. Control by beneficial insects is not treated here, since this aspect is being handled by the Cawthron Institute. In addition there are other methods of control, such as traps and barriers: these, however, are less important, and will be only briefly dealt with.

It is as well to point out here any attempts at artificial control can be rendered almost useless by lack of co-operation among the people concerned. It is of no use for one man to go to a great deal of expense and trouble in dealing with the earwig when his immediate neighbour takes no interest in the matter. This aspect must receive more attention in the future if control is to be successful.

POISON BAITS.

It is not difficult to find a poison that will kill the earwig, the difficulty at present is to find something that is more palatable than is to be found in the orchard. A certain amount of work was first

of all carried out at this Laboratory in order to get a fair indication as to what was the best and most economical poison to use, and the strengths of the solutions required. The poisons used were paris green, sodium arsenite, white arsenic, and sodium fluoride.

Orchardists have from time to time experimented with paris green, but without success. It is probable, however, that they expected the earwigs to die within a few minutes of feeding; this, of course, does not take place, since the poison is slow-acting, taking anything from one to ten days to kill, according to the amount used. In an experiment conducted at the Laboratory paris green was made up according to a standard formula—namely, 1 oz. paris green to 1 lb. of crumbled stale bread, thoroughly mixed, and then made sufficiently damp so that the water can just be squeezed from the bread. When this was fed to earwigs confined in a box 50 per cent. were killed in twenty-four hours and 80 per cent. in forty-eight hours. The formula may be quite useful to town dwellers, but is too expensive for larger areas.

Sodium-arsenite poison was made up as follows: 1 grm. of sodium arsenite dissolved in 100 c.c. of water, 10 c.c. of molasses added, and the whole then mixed with 3 oz. of bran. When fed to the earwigs this material took four days to kill 40 per cent. In greater strengths this would prove too costly. In experiments with sodium fluoride and white arsenic wheat bran was used as a bait at the rate of $2\frac{1}{2}$ oz. to 3 oz. per 100 c.c. of water, with 10 c.c. of molasses added to make it attractive. The bait is made up by dissolving the poison in the required amount of water, then adding the molasses and pouring the whole on to the bran, mixing thoroughly to ensure even distribution of the poison. The results obtained are condensed in the following table:—

Poison used.	Quantity.	Time soaked.	Percentage of Earwigs killed.	Time taken to kill.
White arsenic	1 gramme	20 minutes*	100	2 days.
,, ...	1 ,,	1 hour	20	10 ,,
,, ...	1 ,,	4 hours	30	10 ,,
,, ...	1 ,,	4 days	70	10 ,,
,, ...	1 ,,	6 ,,	100	3 ,,
,, ...	1 ,,	10 ,,	100	$2\frac{1}{2}$,,
Sodium fluoride ..	$\frac{1}{2}$,,	..	80	10 ,,
,, ..	1 ,,	..	85	10 ,,
,, ..	2 ,,	..	90	9 ,,
,, ..	3 ,,	..	100	8 ,,

* Owing to insolubility of white arsenic it was boiled in this instance.

The table indicates that white arsenic, at the rate of 1 grm. per 100 c.c., and soaked for ten days, is so far the best poison to use. There are, however, certain drawbacks attached to the use of this chemical, and comparing it with sodium fluoride we find that the latter has important advantages, since it is less poisonous to human beings and farm animals, and, according to Fulton, is as toxic or more so to the earwig. The latter point, however, is not borne out by the foregoing experiments. Sodium fluoride is far more soluble than white arsenic, and thus easier to incorporate in a poison bait, but, unfortunately, it is much dearer to use. Further experiments with sodium fluoride were not possible, since an additional supply was not obtainable in New Zealand.

These laboratory experiments were carried out in February and March, so that little time was left for field trials. As a preliminary, however, the following work was carried out in Mr. Kinnaird's orchard at Earnscleugh, Central Otago: 1½ lb. of white arsenic was boiled in 12 gallons of water (soaking for ten days would do just as well), 21 lb. treacle was added, and the whole mixed with 10 lb. bran. As a test a handful of the poisoned bran was placed in a benzine-tin containing earwigs, and in twenty-four hours 30 per cent. of the insects were found dead. The bran was scattered close around the base of the trees, and a handful also placed in the tree-crotches. At the end of twenty-four hours a search did not reveal any dead earwigs, though all those seen were very sluggish. This was in part due to a cold snap, and in part no doubt to the poison.

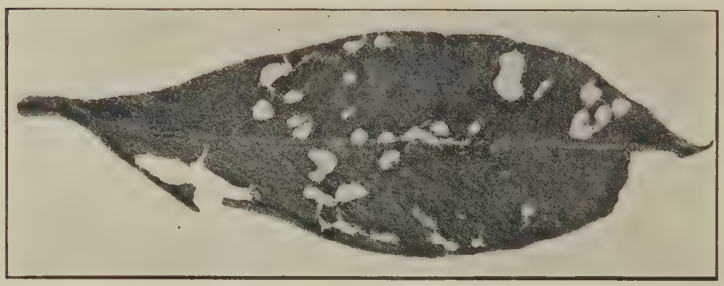

FIG. 4. YOUNG LEAF ATTACKED BY YOUNG EARWIGS.
[*Photo by H. Drake.*

"BARRIERS."

This method of control has a limited application, and, to the writer's knowledge, the only useful barrier in use at present is the commercial preparation Orbite, which has been introduced and used quite effectively by Mr. Hinton, of Earnscleugh. This viscid substance is painted in the form of a band round the base of the tree. Here, owing to its extreme stickiness, it prevents the passage upwards of the insect. It is essential that the base of the tree be kept free from weeds whenever Orbite is used, since long grass and the like forms a passage across the barrier, thus rendering it useless.

The writer experimented with sodium fluosilicate, spreading the powder round the base of the tree. This, however, proved quite ineffective, as under certain conditions, notably after rain, when a crust formed on the surface, numbers of earwigs were found to have passed over the preparation.

FUMIGANTS.

The use of calcium cyanide can be confidently recommended, but owing to the cost it can be used economically only under certain conditions. For example, where boxes are stacked care should be taken to space them at the base, so that calcium cyanide may be blown into the stack by means of a dust-gun. If the stacks of cases are made

small enough for a cover to be thrown over them less fumigant will be required and the control will be more effective.

In the vegetable-garden cyanide dust can be effectively used, particularly among cabbages, where large numbers of earwigs are frequently concealed. Apart from its effect on earwigs the cyanide kills other injurious insects, especially aphids.

The writer does not know of any poison that will kill earwigs as quickly as hydrocyanic-acid gas, which proves fatal to them within one to two minutes after application. Caution is necessary in handling this substance; a tin should never be opened in a closed room unless it is particularly well ventilated; every care should also be taken not to inhale the gas.

TRAPS.

Traps for earwigs have been in use for many years, and various types have been employed quite effectively. One such is to place straw in a flower-pot and invert this over a stake driven into the ground. The earwigs seek shelter in the pot during the day, and the contents may then be shaken into hot water or kerosene and the insects destroyed. Pieces of folded sacking or paper left about in tree-crotches or on the ground may similarly be used. Thus by the use of such simple means numbers of the pest may be destroyed.

NATURAL ENEMIES.

Hedgehogs were introduced at Alexandra (Central Otago) in the hope that they would account for a portion of the earwigs, and having in mind also the fact that these animals destroy other pests, notably snails and slugs. Some of these hedgehogs were dissected by Mr. E. F. Northcroft, of the Biological Laboratory, but no earwig-remains were found in the alimentary tracts of the animals. Further dissections will be made in the coming season.

An examination of the excreta of the brown owl (*Athene nocturna*) showed the remains of a large number of earwigs.

CONCLUSIONS.

No definite conclusions can yet be drawn as to which is the best poison to use, since a good deal of field-work still has to be carried out. It is hoped to make a much earlier start on this phase of the work during the coming season. The main advantage of an early application of the poison lies in the fact that insects when young are more readily* poisoned. With regard to traps and barriers, the main feature of the former is perhaps the personal satisfaction obtained, while the latter, though perhaps effective in keeping the earwigs from certain places, does not reduce the numbers. Calcium cyanide as a fumigant is very useful in confined places, but at present is hardly feasible for control in the open.

For assistance in carrying out the field-work here recorded the writer is indebted to Mr. W. R. Lloyd Williams, Orchard Instructor, Alexandra. Thanks are also due to Mr. Kinnaird, at Earnscleugh, for maintaining a constant supply of earwigs during the laboratory experiments.

*Fink, D. E.: Physiological Studies of the Effect of Arsenicals on the Respiratory Metabolism of Insects. *Jour. of Agricultural Research*, vol. 33, pp. 993–1007.

FUNGUS DISEASE ATTACKING ARTICHOKES.

INCIDENCE, LIFE-HISTORY, AND REMEDIAL TREATMENT.

G. H. CUNNINGHAM, Mycologist, Biological Laboratory, Wellington.

DURING recent years the Jerusalem artichoke (*Helianthus tuberosus*) has been widely grown for pig-feed in New Zealand, and the area is increasing each season. The usual method practised by farmers has been to plant the tubers in drills like potatoes, and when the crop has matured to fence off portions and allow pigs to root out and eat the tubers. When the area has been well worked over by pigs these animals are excluded, and the ground is harrowed, permitting a second crop to mature from those tubers overlooked by the pigs. In this manner certain areas have been kept constantly under artichokes for the past four or five years. One disadvantage of this method lies in the fact that as a rule small tubers only are left by the pigs, the yield in consequence becoming less each season Therefore a modification of this practice is now being advocated by the Department of Agriculture. This consists in lifting, before the pigs are turned on the area, a quantity of large tubers sufficient to plant the area ; then when the pigs have been removed the land is cultivated and replanted with these tubers. In this way constancy of crop-yield is secured.

A more serious obstacle to the utilization of the same land for artichokes for several seasons has arisen during the past few seasons, in the form of a disease which has become widespread. Where at all prevalent it has caused the abandonment of the affected areas, as it may at times destroy half or more of the crop. Fresh plantings have been made, and these in turn become infected, usually owing to the use of seed tubers taken from the previously infected crop.

Requests for information concerning this disease and its possible control have become so numerous that the present article -necessarily incomplete—has been written to supply what information is available.

The disease becomes noticeable in a paddock of artichokes in that certain plants in late spring or early summer show signs of wilting, the foliage becomes blackened, and the plant soon is killed. Generally, death of these initial plants (which are almost always overlooked) is followed by wilt and death of numerous others in their vicinity, until definite diseased areas (or "patches," as the farmer terms them) become well established and then readily noticeable. These areas may continue to increase in size gradually through the season, until in the late autumn they may cover an extent of one-third of an acre or even more. Death of the plant is usually followed by its collapse, and the prostrate discoloured stems then become very prominent (Fig. 1).

Examination of a diseased stem shows the presence, usually near ground-level, but often 1 ft. to 2 ft. above the surface of the ground, of a dense white or light-coloured fungous growth covering the stem often for a foot or more of its length (Fig. 2). The tissues lying beneath this region appear dead and discoloured, and embedded in

the fungous mycelium appear numerous shot-like, usually black bodies of irregular size and shape, termed sclerotia (Fig. 3). Their significance will be made apparent later.

The wilt and death of plants, their frequent appearance in irregularly circular patches, presence of the fungus growth on the cankered portions of the stem, with accompanying sclerotia, are the characters of the disease.

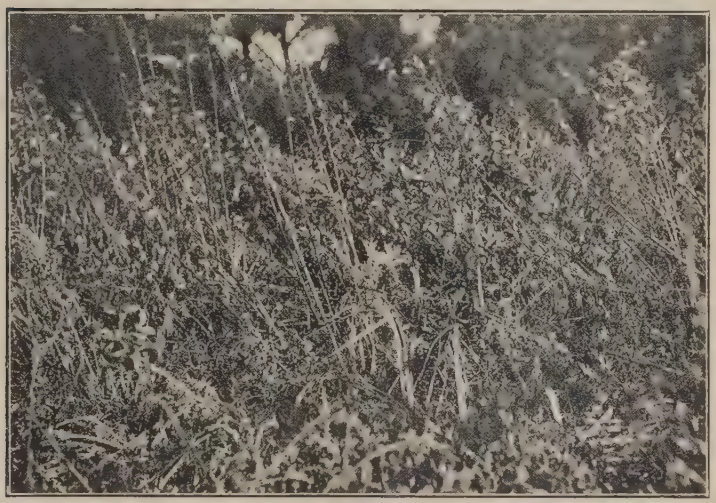

FIG. 1. DISEASED AREA IN ARTICHOKE FIELD, SHOWING NUMEROUS DEAD, FALLEN STEMS.

[*Photo by Writer.*

HOSTS OF THE CAUSAL ORGANISM.

The disease is by no means confined to artichokes, for in New Zealand it has proved one of the most serious fungous diseases with which we have to contend, attacking as it does so many crop, orchard, and garden plants. The following list of plants on which the causal organism has been collected in New Zealand will give some idea of its wide host range: Antirrhinum (cultivated), artichokes (Jerusalem), bean (broad or Windsor, butter, French, horse, soya), Brassicas (chou moellier, cabbage, kale, rape, swede, and turnip), carnation, Cape gooseberry (*Physalis peruviana*), Canadian thistle (*Cnicus arvensis*), carrot, celery, cucumber, curled dock (*Rumex crispus*), dahlia (cultivated), fat-hen (*Chenopodium album*), fennel (*Foeniculum vulgare*), lettuce, lemon (fruits and shoots), mangold, melon, potato, pea, parsnip, pelargonium (cultivated), passion-fruit, spear thistle (*Cnicus lanceolatus*), sweet-pea, sunflower, spinach, tomato, tree-mallow (*Lavatera arborea*), tree-tomato (*Cyphomandra betacea*), tulip, and wing thistle (*Carduus pycnocephalus*).

The disease has with us in certain seasons proved to be one of the most serious troubles of lettuce, potato, sunflower, and tomato.

CAUSAL ORGANISM.

This disease has been found to be caused by the fungus *Sclerotinia sclerotiorum* (Lib.) Mass. (7), an organism which has been in North America usually named *S. Libertiana* Fcl. As it occurs on many hosts it has at times received many different names, those of recent application being *S. intermedia* Ramsey (9), *S. minor* Jagger (5), and *S. perplexa* Lawrence (6); for comparisons of the published descriptions of these show they all agree with *S. sclerotiorum*, differing only in certain characters which cannot be considered as possessing specific value.

FIG. 2. DISEASED PLANT, SHOWING WHITE FUNGOUS GROWTH ON STEMS. REDUCED.

[*Photo by Writer.*

Identification of the fungus on the hosts enumerated was carried out in two ways: (1) The sclerotia were germinated and ascospores obtained; (2) sclerotia were plated to media and their cultural characters studied. These were compared with cultures made from ascospores, and all were found to agree to the extent that separation of any one was not possible, although considerable variation was noted in certain particulars, such as growth-rate of the mycelium, size of sclerotia produced on media, &c. Apothecia were obtained from germinated sclerotia taken from artichoke, carrot, celery, cucumber, lettuce, pea, potato, tomato, and tree-mallow.

LIFE-HISTORY.

Opinions differ among pathologists as to the method by which infection occurs in the field, one view being that ascospores produced from germinating sclerotia in the spring cannot attack the host directly, but must first develop a copious saprophytic mycelium (presumably in the soil) which later attains the parasitic condition. This statement is invariably attributed to de Bary, but, as Pethybridge has pointed out (see below), his original statement did not convey this meaning. This opinion was regularly held by most of those who have published on this organism, until a paper by Pethybridge appeared (8), in which direct infection by ascospores of potato-haulms was secured. His observations are so informative as to bear reproduction:—

> In the spring and summer these sclerotia, which are then to be found in and on the soil, germinate and produce stalked "spore-cups" (apothecia), from which little puffs or clouds of spores can be seen to proceed. Nothing could be simpler than to suppose that the potato-plants become infected directly from these air-borne spores. Arguments have, however, been brought forward which seem to show the impossibility, or at least the improbability, of this mode of infection. Thus de Bary found that when the spores germinated in water the germ tubes were

quite unable to penetrate the living healthy tissue of the plant. If, however, germination took place in a nutritive solution, instead of in water only, the germ tubes were found to be capable of producing infection. So impressed was de Bary with this difference in behaviour of the spores according as to whether they germinated in pure water or in a food solution that he went so far as to state (3, p. 380) that the fungus always requires to pass through a previous stage of existence as a saprophyte in order to be capable of parasitism. The expression "previous stage of existence" appears to have had a somewhat exaggerated importance attached to it, at least from the practical point of view, and has led to the idea being promulgated that in one stage of its life-history the fungus lives saprophytically—*i.e.*, in decaying manure or organic matter in the soil—and hence it has generally been maintained that the potato-plant becomes attacked at soil-level by the invasion of saprophytically nourished mycelium from the soil. This view of the mode of infection by this fungus is, of course, supported by the experiments carried out by de Bary on potted plants of zinnia (2, p. 378). Ten of such plants were contained in a single pot of soil, and placed in contact with the base of the stem of one of them was a piece of carrot on which the fungus was living. Ultimately nine out of the ten plants succumbed, the attack in each case taking place at the soil-level. This result can scarcely be regarded as surprising, but it is not necessary to conclude from it that in the field the attack must always come from the soil . . . Up to the present, at any rate, no one has reported the finding of this fungus living naturally in the soil as a saprophyte.

It is true that in the case of the potato the point of attack is often at or near soil-level . . . But . . . the points of attack are very frequently found a considerable distance above soil-level, so that there can be no question of infection from the soil at such places.

In the same paper Pethybridge records experiments in which he proved conclusively that haulms and leaves could become infected directly by ascospores. He further remarks (p. 17) :—

Observations of plants in the plots strongly suggest that in the main an entry into the plant is gained in two or three ways. The first of these is through the older, shaded, yellowing leaves, which ultimately fall off. The fungus is not infrequently found on them, and makes its way down the leaf-stalk, and thus its mycelium reaches the stem of the plant and enters it. It seems quite possible that the germinating spores might be able to secure an entry into such dying leaves, whereas they would still be unable to directly infect perfectly healthy ones . . . The second point of entry which suggests itself consists of the series of wounds left on the stalks by the falling leaves. In any case it is a fact that far the greater number of cases of infection occur at a node . . . The essential fact which has been brought out by those experiments of the past season remains —viz., that the attack of the potato-plant with this disease takes place chiefly from aerially-borne spores, and not, as has hitherto been maintained, from the soil.

Dowson (4), working with this organism on antirrhinums, was able to produce infection when ascospores were either inoculated into wounds or placed directly on the host-tissues. He also succeeded in obtaining infection with mycelium. Ramsey (10) was able to produce severe infection by spraying a suspension of ascospores over the freshly cut leaves of lettuce. Thus recent workers have shown ascospore infection of the host occurs quite readily.

Field observations on artichokes show that infection some distance above the ground is quite common ; and from what has been written it is obvious that such infection must occur from ascospores. Consequently, despite the observations of earlier workers, ascospore infection must be considered as the source of primary infection. This view is strengthened by the fact that these early infections occur in late spring or early summer, the period when apothecia are readily obtained from germinating sclerotia. Sclerotia, as has been shown, are black, shot-like bodies produced in numbers on the cankered

portions of the stem. When mature they fall to the ground, where they usually remain quiescent until the following spring. They are in reality compact bodies composed of intricately interwoven hyphæ. From them arise under favourable conditions (in the spring, during periods when abundant moisture is present, though they are not uncommonly produced through the summer months) stalked, saucer-shaped, light-coloured structures termed apothecia. These bear on their upper surfaces numerous cylindrical sacs, each containing eight spores. These are discharged forcibly into the air and are carried to plants in the vicinity. Here, conditions being favourable, infection occurs, and a mycelium is produced, which penetrates the plant-tissues, killing them and blocking the conduction-vessels. As a result, wilt and death of the plant follows, the mycelium at the same time growing to the surface of the attacked portion, where it produces sclerotia, which eventually fall to the ground.

FIG. 3. SHOWING BLACK SCLEROTIA ON STEMS. HALF NATURAL SIZE.
[*Photo by Writer.*

The disease frequently does not spread beyond these initially infected plants, its spread being dependent to a large extent on a high moisture content of the soil and vicinity. Usually, however, it spreads to contiguous plants, forming a small diseased patch; or it may spread rapidly over a considerable area, until in extreme cases all plants within an area of one-third of an acre may be killed. The manner of the spread of the disease from the initially to subsequently infected plants is not known, but, judging from the number of stems infected well above ground-level, it is probable that here, too, ascospore infection is chiefly responsible.

Remedial Treatment.

Inspection of diseased plants shows that partial or complete infection of the tubers is frequent—this, of course, depending on the period at which infection occurs. When tuber-infection is severe most of them rot, sclerotia being produced in abundance on the exterior of decayed

tubers. Others may show slight infection, which often escapes notice, and it is these tubers, often with one or several sclerotia attached (frequently inevident, as they are in the bases of the buds and are usually covered with earth), that carry the disease to clean land. As has been shown, once a crop becomes infected the disease persists in that crop, being carried over from season to season by the sclerotia remaining in the soil. On clean land—land out of grass—such bodies are not present; therefore it is obvious that the disease must be carried to the ground on the seed tubers when it appears in artichokes growing therein.

This knowledge enables us to prevent the disease becoming a serious trouble to those desirous of growing artichokes for pig-feed. But, unfortunately, nothing can be done to prevent infection in those areas where artichokes are already established and in which the disease is present. Therefore, when the disease is severe such areas should be abandoned and sown to grass; for when the host range of this fungus is considered it will be seen that it is unsafe for the farmer to sow on infected land for at least two seasons such crops as mangolds, peas, potatoes, &c.

When it had been determined that the disease was carried in the tuber the writer carried out numerous experiments with a view to ascertaining whether the organism could be destroyed without detriment to the tuber. Tubers were washed, and dipped for varying periods of time in mercuric-chloride solutions according to formulas published elsewhere (1) for the control of corticium-disease of potatoes. They were then planted in boxes. Results showed that artichoke tubers would not tolerate immersion in these solutions, those dipped for five minutes only in 1–1,000 $HgCl_2$ rotting in fifteen days after treatment. Moreover, at this strength the fungus was not killed, growth being readily obtained from sclerotia plated to media from the dipped tubers.

Further, it was found that the disease often was present in mycelial form within the tubers, being present in discoloured tissue at the ends by which the tubers were attached to the parent plant. Penetration of a fungicide through this tissue is not possible, so that, even were a solution evolved capable of killing the sclerotia on the exterior, the disease would still be carried in this diseased tissue. It was found necessary before treatment to wash tubers free from all attached earth, and it was during this operation that the stem-end diseased areas containing mycelium (and often sclerotia) of the pathogen were noted.

Thus remedial measures would consist in using disease-free tubers for planting. To obtain these it would be necessary to take seed tubers from a field in which the disease apparently was absent, to wash these free from soil, and to discard *any* showing discoloured spots. In addition it would be necessary to plant on land which had not been under swedes, turnips, mangolds, vegetables, peas, beans, garden flowers, &c., for at least two seasons previously. In fact, it would be advisable to use for the purpose ground which had been in grass for some two or three years. Although the disease has been found on such weeds as curled dock, spear and wing thistles, fat-hen, and Canadian thistle, its occurrence on these hosts in nature is so rare that

danger of infection from these sources may be overlooked, especially where lea land is to be used for planting.

Finally, farmers are warned against feeding to pigs on land in artichokes (or to be used for this purpose) diseased bulbs of swede and turnip, garden vegetables, or the like, or feeding such to pigs in pens and dumping the manure from the pens on land to be used for artichokes, for it is in this manner that infection frequently occurs.

A second possible method of dealing with this trouble has recently been brought to the writer's notice by Mr. N. R. Foy, Seed Analyst. While on a recent visit to Taranaki Mr. Foy found that certain farmers in the Eltham district were growing the pink instead of the usual white variety of artichoke, for they claimed that this variety was highly resistant to the disease. The pink variety is not such a prolific cropper as the white; nevertheless, if resistant, it is worth consideration, for it could then be more safely planted on the same land on which whites had been severely infected.

The writer is indebted to Mr. K. W. Gorringe, Instructor in Swine Husbandry, Department of Agriculture, Wellington, for particulars regarding the methods used in growing and feeding off artichokes; to Mr. N. R. Foy, Seed Analyst of this Laboratory, for particulars concerning the use of artichoke varieties in Taranaki; and to Mr. A. C. Buist, New Zealand Farmers' Co-operative Association, Ltd., Feilding, for conducting him to diseased areas in that district, procuration of specimens, and the like.

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Agricultural Legislation.—Drafts of the following Bills have been recently considered and approved by the Board of Agriculture: Fertilizers, Importation of Plants, Staining of Imported Seed, Stock Amendment, and Noxious Weeds Amendment.

HOT-WATER TREATMENT OF SEED BARLEY.

FIELD EXPERIMENTS IN CANTERBURY.

C. H. HEWLETT, Canterbury (N.Z.) Seed Co., Ltd., Christchurch.

ACTING on the advice and with the assistance of Mr. J. C. Neill, Field Mycologist, Department of Agriculture, the writer commenced in 1925 a series of experiments on a practical scale with the hot-water treatment of seed barley. The primary object of this work was to reduce or, if possible, eliminate the barley-smuts from the malting-barleys of Canterbury; but also it was hoped that the method might produce a healthier and more vigorous plant, and so improve both the quality and yield. The results of two seasons' work, presented below, though not conclusive until confirmed by further experience, are sufficiently striking to warrant publication.

Season 1925–26.

On 28th and 29th May, 1925, 100-bushel lots of the Kinver Chevalier and Plumage varieties were taken from our stock lines of seed barley, placed in special hessian bags holding loosely packed 30 lb. each, pre-soaked in water held at 80° F. for six to eight hours, and then dipped for ten minutes in water held at 127° F. On removal from the dip the bags of barley were cooled, and then emptied on to the drying-floor of a 27 ft. by 27 ft. malt-kiln and dried at 90°–100° F. for twenty-four hours, then dropped to 85–90° for a further thirty-six hours.

Samples were taken for germination, the tests being made at the Agriculture Department's Seed-testing Station, with the following results :—

Table 1.—Germination Tests.

Period after Dip.	Treated Chevalier.			Untreated.			Treated Plumage.			Untreated.		
	Three Days.	Six Days.	Final	Three Days.	Six Days.	Final	Three Days.	Six Days.	Final	Three Days.	Six Days.	Final
	%	%	%	%	%	%	%	%	%	%	%	%
Four months	9	78	84	..	100	100	19	86	88	..	100	100
Six months..	20	71	92	95	99	100	38	87	95	98	100	100

It will be seen that the treatment adversely affected the germinative vigour of the seed.

The treated seed was supplied to farmers growing barley on contract for the Canterbury Seed Co. The spring of 1925 was very cold and wet, so that sowing was greatly delayed and the soil in very bad condition. Germination on the whole was bad, and the treated grain came through so slowly that several growers ploughed up the whole or part of their treated seed. However, a sufficient area was left to demonstrate that the treated seed, though making such an apparently bad start, in the end caught up and surpassed the untreated seed both in yield and quality. Moreover, it was absolutely free from smut in a year in which smut was particularly prevalent and destructive in all

the crops the seed for which had been treated by the usual bluestone or formalin methods.

The results for the season are detailed in the following table :—

Table 2.—Yield Results.

Treated Chevalier: Yield per Acre.	Untreated: Yield per Acre.	Treated Plumage: Yield per Acre.	Untreated: Yield per Acre.
Bushels.	Bushels.	Bushels.	Bushels.
57·3	40·7	41·1	34

NOTE.—Yield figures are for firsts only; seconds not counted.

The product of the treated seed was threshed by an ordinary combine without any precautions being taken to disinfect the machine.

Season 1926–27.

Acting on the experience gained in the previous season's work, and on Mr. Neill's further work on smut-control, the time of dip was reduced from ten minutes to five minutes at 127° F., and the time of presoak from six–eight hours to five–six hours at 78° F.

Samples were taken for germination tests, with the following results :—

Table 3.—Germination Tests.

Period after Dip.	Treated Chevalier.			Untreated.			Treated Plumage.			Untreated.		
	Four Days.	Six Days.	Final	Four Days.	Six Days.	Final	Four Days.	Six Days.	Final	Four Days.	Six Days.	Final
	%	%	%	%	%	%	%	%	%	%	%	%
Nine days ..	72	93	98	97	99	100	58	87	96	99	100	100
Twenty days	72	82	94	99	100	100	73	84	93	98	99	100

It will be seen the germinative vigour of the seed was much less adversely affected than under the preceding season's treatment.

The seed "direct from treatment" was sown on the Canterbury Seed Co.'s farm at Leeston, and the product was absolutely free from smut. The product of the 1925–26 crop (called "once removed from treatment") was sown on the company's farm at Leeston, and was also supplied to twenty farmers growing barley on contract for the company in the Ellesmere district. The seed was all machine-dressed; the grain-cleaning machines were cleaned out and disinfected with a strong solution of formalin, and the sowing-drills treated in a similar manner.

Details of results are given in the following tables :—

Table 4.—Yield of Seed "direct from Treatment."

Where grown.	Chevalier: Yield per Acre.	Plumage: Yield per Acre.
Canterbury Seed Co.'s farm, Leeston ..	67·84 bushels.	80·64 bushels.

NOTE.—All absolutely free from smut. Yield figures are for firsts only.

Table 5.—Yield of Seed "Once removed from Treatment" and Untreated Seed.

Ellesmere District.	Once removed from Treatment.			Untreated.			Increased Yield over Untreated.	Total Acres.
	Number of Farms.	Acres.	Yield per Acre.	Number of Farms.	Acres.	Yield per Acre.		
			Bushels.			Bushels.	Per Cent.	
Chevalier ..	21	499	62	39	882	55·32	12·07	1,381
Plumage ..	4	49	57·24	16	223	52·18	9·69	272
Total ..	25	548	61·57	55	1,105	54·68	12·60	1,653

The product shown in Table 5 was graded as follows :—

Table 6.—Grading of Product.

Quality.	Chevalier.		Plumage.	
	Treated once removed.	Untreated.	Treated once removed.	Untreated.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
First grade ..	96·8	81·97	94·9	62·55
Second grade ..	3·2	8·85	5·1	21·30
Under grade ..	Nil	9·18	Nil	16·15
Total ..	100	100	100	100

It was anticipated that the product of the "Once removed from treatment" seed, which latter was threshed in 1926 through an ordinary combine, would in consequence thereof be slightly reinfected, and the crops therefore not be entirely free from smut. Upon an inspection of the crops in January, 1927, by Dr. G. H. Cunningham, Mycologist, Department of Agriculture, and Mr. Neill, this forecast was borne out by the fact that while all the crops grown from "directly treated" seed were absolutely free from smut, of the crops grown from seed "once removed from treatment," threshed through an ordinary combine, only those grown by W. O. Rennie, George Osborne, and the Seed Company, comprising 87⅝ acres, were absolutely free from smut, the remainder being slightly infected. A comparison of the results as set forth in Table 7 are most interesting. All the crops in question were Chevalier.

Table 7.—Comparison of Results: Smut-free and Slightly Infected Crops.

Seed once removed from Treatment; threshed through Ordinary Combine.				Untreated Seed.		Increased Yield of Crops free from Smut.	
Crops free from Smut.		Crops slightly infected.					
Acres.	Yield per Acre.	Acres.	Yield per Acre.	Acres.	Yield per Acre.	Over slightly infected.	Over untreated.
	Bushels.		Bushels.		Bushels.	Per Cent.	Per Cent.
87⅝	69·82	411½	60·33	882	55·32	15·73	26·21

Yield figures for firsts only.

The fact that the areas free from smut yielded 15·73 per cent. more than the slightly infected, and 26·21 more than the untreated, is a point of great significance.

The results obtained so far show that the treated seed has produced an improvement both in quality and quantity.

Acting on the experience gained, and with a view to preventing reinfection when harvesting the smut-free crops of the past season, the reapers-and-binders were cleaned and disinfected with a strong solution of formalin before reaping operations commenced, and a new threshing-machine was employed to thresh the grain, the machine being thoroughly cleaned out and disinfected with formalin before threshing each separate crop.

GERMINATION OF HULLED OATS.

THERE has been some inquiry lately as to whether the hulled grains of oats germinate, the popular opinion being that they do so. Several series of tests carried out at the Seed-testing Station, Wellington, show that only a small percentage of such grains do grow. The accompanying photograph shows hulled and unhulled grains from the same sample

HULLED (LEFT) AND UNHULLED OATS UNDER GERMINATION TEST.

under test, and the difference in vitality and proportion of growth of the two types can be plainly seen. The actual result was—unhulled, 98 per cent.; hulled, 15 per cent. It is intended to make a study at this Station of the germination of hulled seeds generally—rye-grass, cocksfoot, &c.—and the results will be published in due course.

—*N. R. Foy, Seed Analyst.*

THE PRUNING OF ORCHARD TREES.

(Concluded.)

W. K. DALLAS, Orchard Instructor, Dunedin.

PIP-FRUITS: APPLE AND PEAR.

THE bearing habit and growth of the apple and pear are almost similar, and these factors will largely dictate the style of pruning to be adopted. The fruit-bearing buds and spurs are not generally formed upon shoots produced during the past season, but are to be found developing on wood two years old and on older wood. Generally speaking, there are two types of trees—free spurring (*e.g.*, Sturmer) and lateral bearing (*e.g.*, Jonathan).

The head of the mature tree should be kept sufficiently open, so that sunlight may penetrate to all parts. The trees, without interfering with the production of good crops, should be kept in a good growing condition. The ideal bearing-tree is one that is making good growth and bearing good crops. The leaders should be kept dominant. They require to be shortened back to some extent annually, but just how far in respect to each tree is a matter which must be decided by the pruner himself. Trees which normally grow erect (most varieties of pears do) should be cut to outside buds in order to induce them to spread. For trees of the spreading habit it is recommended that the leader growth should be pruned to buds on the upper side of the shoots.

In vigorous growing trees there are usually many more laterals produced than are required, and these should be thinned out so as to avoid overcrowding. In the average good growing and bearing tree, which has been well pruned, little thinning out of laterals should be necessary. When thinning, the shorter, well-developed, mature laterals should be preserved in preference to strong, heavy shoots. In normal trees, where it is necessary to retain strong, vigorous laterals, these should be cut back to a length of from 10 in. to 18 in., according to the variety and to their position on the tree. On very vigorous trees they would require to be left longer.

In free-spurring trees the first season's laterals of normal length—10 in. to 18 in., according to variety—after being thinned out in such a manner as to provide an even distribution over the tree, may be left uncut; or, if the pruner chooses, they may be cut back so as to remove the terminal buds. It has been observed that the buds occupying positions along the middle third of the length of a lateral or shoot are the best-developed buds for fruiting purposes. In leaving these laterals uncut or by slightly shortening them the normal development of these buds into fruit-buds is not interfered with. This practice is a better means of encouraging the development of fruit-buds than cutting back laterals to four or five buds, as has been commonly practised in the past.

Second-season laterals when the pruning season comes round will have developed one or more fruit-buds, and will have made one or more extensions from the topmost buds. The practice recommended is to cut back the second-year lateral to the lower of the new laterals, which in turn should be cut back to a bud from 4 in. to 6 in. from its

base. As far as possible the cutting of the second-year lateral back to the fruit-buds should be avoided. It is desirable to leave some new growth beyond these fruit-buds for carrying foliage to provide sufficient elaborated sap to nourish the buds and fruit which may be borne by the lateral.

The third-year lateral will probably have developed short spurs as well as a number of fruit-buds. This lateral usually requires only light pruning. It should be treated in a manner similar to that of the previous year by leaving a little new growth beyond the fruit-buds or spurs. In trees such as the Sturmer, where fruit-buds develop freely, it may be necessary to thin out some of the fruit-buds in order to avoid overcropping. Weak, spindly, and surplus laterals should be thinned out.

In subsequent years the pruning will mainly consist of thinning out the fruit-spurs and fruit-buds, a shortening of laterals, and the cutting-out of injured, diseased, and worn-out parts of the trees. The trees must be kept growing moderately vigorously. The pruner is warned that trees of this habit of fruit-bearing, if not normally vigorous, will readily overbear themselves under this system of pruning unless they are carefully treated. In addition to a judicious bud and spur thinning at pruning-time, overloaded trees should be sufficiently thinned before the fruit exceeds ½ in. in diameter. Trees showing a tendency towards weakness should be kept well cultivated and manured.

The lateral-bearing type of tree requires to be kept in a vigorous growing condition in order to produce regularly a sufficient quantity of well-matured growth. If this is done—and it is necessary that it should be in the Jonathan—very little difficulty will be experienced in successfully pruning these trees. Where necessary, the laterals should be thinned out to avoid overcrowding. All first-season laterals of normal length, about 12 in. long, which are retained should be left unpruned, as the terminal bud is usually a fruit-bud which will bear fruit during the season. Strong lateral growths which may be retained require to be cut back about one-third of their length. Occasionally fruit-buds are developed on these strong first-season shoots, and in some seasons they also develop on vigorously growing leaders. In pruning laterals on the Jonathan the pruner should cut back a lateral only to a well-developed leaf-bud or to a well-developed lateral growth. When laterals are cut back to dormant or small imperfect buds near the base these buds usually fail to respond and the stub dies.

Second-year laterals, as in the spurring type, will develop one or more fruit-buds. In the Jonathan they are the principal fruit-bearing wood. The shorter of these laterals which have made little or no extension during the past season may be left unpruned. Those which have made good growth should be cut back to a well-developed leaf-bud, or to one of the stronger lateral extensions. In order that the correct treatment may be given to the laterals before him a pruner must exercise his own judgment as to where they should be cut. Throughout the pruning of this tree it should be kept in mind that in order to maintain fruitfulness over a period of years it is necessary to stimulate new growth with which to replace the worn-out laterals. Weak, immature growth should be thinned out.

To obtain the best results with the Jonathan, which is of a spreading habit, the tree must be kept growing as directly upright as possible Sharp-angled bends on the leader growth should be avoided, as they restrict the sap-flow. It is also essential that a sufficient supply annually of well-developed two-year-old wood should be available to maintain the fruitfulness of the tree. This growth may be obtained by judicious pruning, by a judicious thinning-out of all weak and immature fruit-buds, by the thinning of the fruit, and by cultivation and manuring where conditions render these necessary.

THE GROWTH OF PHORMIUM TENAX.

SOME FURTHER NOTES.

G. SMERLE, Kaihere, Hauraki Plains.

PHORMIUM TENAX reproduces itself in two different ways: by sexual reproduction—that is, by seed; and by vegetative reproduction—growing new fans from the old ones, and also by producing young fans from the rhizome. Fans springing up from the rhizome are much smaller when they appear than those produced from old fans, and a year or so longer is required for them to grow to a size suitable for milling.

The vegetative reproduction is the most common form in our wild-growing phormium areas. In a good soil and in good environment a fan of twelve to twenty months old will produce from one to two, and even three, baby fans. These fans, when they attain the age stated, will in turn reproduce, and so on. Nearly all fans produced vegetatively flower in the third year of their growth, and after maturing the seed the fan dies. Seedling plants which come up in wild-growing phormium areas where cattle or sheep are grazed have very little chance of growing to maturity, because the stock pull up the young plants, and in such areas regeneration by seedlings cannot take place.

Plants reproduced by vegetative means tend to weaken, and the offspring may be said to be as old as the parent plant. This is confirmed by the fact that phormium produces every third year a specially large quantity of flower-stalks. Millers call that year a "crady" year, this term apparently arising from a corruption ("koradi") of the Maori word *korari* for the flower-stalk. If every fan produced a flower-stalk every third year, then there would be every year a similar amount; but that is not the case. Carefully examining bushes in the flowering year, one finds that many year-old fans have produced flower-stalks. It is remarkable that the intensive flowering year coincides all over the North Island, and probably also over the South Island.

Seedling plants—that is, plants by sexual reproduction—are more vigorous growers and more disease-resistant than plants from old fans. For breeding new and better varieties, sexual reproduction is indispensable. Seeds sown by the writer on 5th March started to germinate on 10th April, and seeds sown on 18th August commenced

to appear on 12th October. Only a small proportion of seeds will germinate in this time; the majority will take much longer. It was noted that from seeds sown on 15th September a few germinated on 19th October, some on 25th February, and a few stragglers appeared on 17th April following. The average time for germination is from three to seven weeks, and a good germination will give 65 to 75 per cent. of seedlings.

Seedling plants kept clean of weeds and growing in good soil will produce a young fan after eight months' growth, and a year-old seedling will have two to three of these baby fans. A single two-year-old seedling plant, if planted in good soil at the right distance and cultivated, will produce from six to twenty new fans in two and a half years' time. Plants which produce many fans have narrower leaves than plants of a similar variety with fewer fans in the bush.

Dense bushes with narrow leaves produce less fibre than bushes of similar variety with wide leaves. In cultivated soil and spaced at a suitable distance a plant will produce wider leaves and of a better fibre content than in uncultivated soil. A properly grown plant will produce leaves from 6 ft. to 9 ft. high in two and a half years' time. A few of the seedling plants will produce flower-stalks in the fifth year after the seed was sown, and the young fans of that flower-stalk fan will flower in the third year after their appearance.

It will be seen that the period of growth of most fans is three years. Exceptionally, a fan grows for a longer time, even if it has sprung from an old one, but such cases are very few. The fact of the special flowering year indicates this very plainly. In the writer's previous notes (*Journal*, January, 1927) it was shown that the leaf in the fan is ready for milling in about a year's time, and that all the leaves die before they are two years old. By the hook-cutting method millers have to wait from three to four years until the cut plants attain a millable size. During this long period they lose many leaves and also many fans.

Recent experiments by the writer show that the best fibre is obtained from leaves eleven to fourteen months old. Leaves fourteen to sixteen months old (those of sixteen months being the oldest that could be used for milling for the experiment) gave coarse and rather brownish-looking fibre, and the scutched-fibre percentage was lower than that from the leaves eleven to fourteen months old. Following are the details:—

Age of Leaves in Months.	Green Weight.	Weight of Unscutched Fibre.	Percentage.	Weight of Finished Fibre.	Percentage.
	lb.	lb. oz.		lb. oz.	
4 to 6	18	2 6¼	13·28	1 1	6·00
8 to 11	13	1 7⅜	11·39	0 13	6·25
11 to 14	14	1 11¼	12·16	0 13	7·59
14 to 16	17	2 6⅜	13·56	1 4⅜	7·35

The hand scutching was rather severe; with an automatic scutcher the finished fibre content would have been higher. Test scutching cannot be done satisfactorily by hand. The operator always tends to scutch the experimental hanks for a longer time than the usual fibre.

SEASONAL NOTES.

THE FARM.

AUXILIARY FEEDING.

JULY is often the most severe month of winter, and one of the farmer's main cares at this period will be to see that his stock receive not only sufficient fodder to rebuild tissue but enough to maintain ample bodily warmth. It may have been found necessary to husband the hay and other forage until now, but no pinch should be allowed in July. Specially important is this in the case of pregnant ewes and cows due to calve in early spring. Scant feeding may not only impair the milk-flow of the ewe or milch cow—it may actually endanger the whole future of the offspring.

On farms where a variety of root crops are grown the swedes will be fairly well cleaned up by the end of July, and the carrots should be fed next. Carrots are ideal for cows when they first come into profit, and as they usually start a new growth about the end of August it is better to use them earlier when at their best. Mangolds will keep longer than any other root, and the longer, within limits, they are kept the better their feeding-value. For this reason they should be the last root fed in winter and early spring.

Chou moellier is now extensively grown, and there are quite large areas being saved for July and August feeding. Generally this forage is in good condition in July, but August frequently sees a new growth and a tendency to run to seed. When in this condition there is some danger of it inducing redwater if cows are turned on to the crop. At this period of the year it is safer to cut the forage and let it wilt to some extent before being fed to stock.

Feeding-off of autumn-sown cereals should be done before the crops become too rank. Generally speaking, two light feedings will be better for the crop and the stock than one heavy feeding.

PASTURE-MANAGEMENT.

Where rough feed still exists it will now be good practice to get it eaten out and the paddocks thoroughly cleaned up and harrowed about the end of July in preparation for the early spring growth. Old herbage that has stood in winter has very little feeding-value, and in the case of in-calf cows frequently does considerable harm by bringing about compaction. On the higher country where spring is late this cleaning-up may be left a month later. It sometimes happens on dairy farms where plenty of roots, hay, and ensilage are provided that difficulty is experienced in getting paddocks well eaten out. In such cases it is a good plan to either buy a few hungry store cattle for the purpose or give the grazing to some other farmer who owns this type of cattle.

Hay and roots should be fed on the poorer and older pastures, and the drier situations chosen for the purpose. This is a sure method of raising the fertility and introducing grass-seed on to bare places. The hay should be distributed across the field, so that the beneficial effects may be well spread. Exception can be made in the case of patches

which are infested with grass-grub, on which the feeding-out may be concentrated. The incidental consolidation and reseeding will be found useful in controlling this pest.

Tripod harrowing is one of the cheapest and most profitable operations on the farm, and there are few better ways of utilizing days when other work cannot be undertaken. The maintenance of a good pasture depends on a healthy root-system, and letting the air into the turf is of great importance in promoting this condition. Although chain harrowing is useful for the spreading of animal-droppings, it is of little value for surface cultivation, and the majority of our old pastures need far more drastic treatment than they are now receiving. The best time for doing this work is when the ground is moderately damp or during showery weather.

Rolling, especially on light land, will benefit young grass, but this operation should not be carried out on a frosty morning.

Any top-dressing still to be done should now be pushed on, so that all such manuring for this season may be finished by the middle of August. It is satisfactory to note that most grassland farmers are taking advantage of the present low prices of phosphatic fertilizers to largely extend their top-dressing. The average farmer cannot afford *not* to top-dress.

SEED PEAS.

Ground being prepared for commercial crops of seed peas should be well cultivated throughout July and manured. In localities where late frosts are not generally experienced, early sowing—about the last week in July—is advantageous.

—*Fields Division.*

THE ORCHARD.

PRUNING.

THE most important work at this period of the year is pruning, which in all the larger orchards should be pushed on as fast as possible, so that it may be completed before the trees break into growth in the spring. The special article on pruning commenced last month is concluded elsewhere in this issue of the *Journal*. It may be added that the larger wounds should be cut smooth with a sharp knife and then given a coating of paint or tar, in order that the cut surface may not be exposed to the attack of fungi. All prunings, large and small, should be gathered and burnt as soon as possible, so as to minimize the spread of disease.

GRAFTING AND BUDDING.

Trees which it is intended to bud in the spring may now be cut down to within 2 ft. of the position at which it is intended to insert the grafts. A clean, fresh cut should be made at the time of grafting. It is generally advisable to graft the older trees about 6 in. to 12 in. above the point where the limbs fork. Stone-fruit trees which it is intended to bud in January or February should be cut back to just above the forks, so as to induce suitable new growth for budding into.

CULTIVATION.

Ploughing may be carried out where the land is in a suitable condition, and should be completed as early as possible. A depth ranging from 3 in. to 8 in., according to the age of the trees and the depth of the roots, is usually sufficient to turn in and cover the weeds or green crop. When ploughing close up to the trees the depth should not be greater than from 3 in. to 4 in.

MAINTENANCE OF PLANT.

During the winter months advantage should be taken of wet days to clean, oil, repair, or paint harness, tools, and implements, &c. The spray-pump should be the first to receive attention, and the whole outfit should be thoroughly overhauled and put in good working-order. In localities subject to heavy frosts no liquid should be left in the pump, otherwise the latter may be seriously damaged.

HARES AND RABBITS.

These animals sometimes cause considerable damage to young trees at this time of the year. In localities where they are present the orchard should be netted in. All netting fences should be examined carefully, and any holes which may be found repaired at once, at the same time clearing out any of the pest which may be in the orchard. Where netting is not provided the trees should be securely bandaged with newspaper or painted with a mixture of oil and horse-manure. The oil mixture is usually effective from three to five nights, and it is necessary to renew the application at intervals until all danger is past. On laterals and young branches or leaders the oil should not be stronger than 1 in 4.

FRUIT IN STORAGE.

Fruit in cool and ordinary storage should now be examined at frequent intervals. Apples should be disposed of while sound and in good condition, and before they show any sign of shrivelling or become overripe. Overmature fruit will not stand the handling that freshly picked fruit will, and frequently arrives on the market in an unsaleable condition. Pears should be disposed of before they become too yellow and ripe. All stored fruit should be repacked before it is placed on the market.

SPRAYING.

Experience has shown that what is termed winter spraying is usually best delayed until early spring. In circumstances where it may be considered advisable, however, a heavy winter dressing of an insecticide or fungicide can be applied.

—W. K. Dallas, Orchard Instructor, Dunedin.

Citrus-culture.

It is far too general at this period of the year to find the citrus-groves overgrown with weeds and misplaced planted cover-crops. Although it is desirable to allow a wealth of green stuff to grow, to be later turned under, this growth should be controlled. If allowing vegetation to

grow means that the soil becomes sour it is best to choose the lesser of two evils and turn the land over in order to allow excess water a chance to dissipate. The same amount of humus may not be added to the soil, but lack of humus is preferable to excess moisture. Where the land is well drained and a heavy cover-crop allowed to grow, this should still be controlled to the extent of keeping the area immediately under the tree in a state of clean cultivation. Neglect of this results in loss of soil-sweetness, with a consequent setback to the tree. Excessive weed-growth also often results in the softening of trunk-bark to an extent which leaves it less resistant to the various forms of rot that readily attack that part of citrus-trees.

Pruning: Some pruning will be required among lemons, where growths from 3 ft. to 4 ft. in length of an extended unfurnished nature are often found. These were made during the past autumn, and will naturally divide at the tips towards springtime if left uncut, giving the tree that form of straggly growth so difficult to deal with later without loss of crop. These long shoots should be pruned now to about half-length; they will then give rise to side growths of a good fruiting habit where required by the grower. It is possible that if all such long shoots are so treated the tree will become too bushy and compact. In this event only the required number for which good space can be found should be allowed to remain.

—W. H. Rice, Orchard Instructor, Auckland.

POULTRY-KEEPING.

THE BREEDING-PENS.

THE season has now arrived when the breeding-pens should be mated up. This is one of the most important phases in the poultry-keeper's year. It is, indeed, a time when his judgment is put to a severe test—that is to say, if the good qualities of his stock are to be improved or maintained. In the work of selecting the breeding-birds the first essential is to have purebred stock to select from—good specimens of the breed they represent. Therefore, if any real advance is to be made in holding the good qualities of a flock, the poultry-keeper must necessarily have a knowledge of the standard requirements of the particular breed or breeds he is working with. In order to become familiar with the various standard types of the most useful and popular breeds of poultry the novice cannot do better than study closely the plates, together with the text describing the breed characteristics, in the Dominion Utility poultry Standards. Copies of this booklet are obtainable from the Publisher, Department of Agriculture, Wellington, at a cost of 3s. each, postage free.

It is pleasing to notice that utility poultrymen are now taking a greater interest in the poultry shows of the Dominion. It is to be hoped that the show movement will rapidly spread and increase in importance, as this is practically the only means we have of preserving in a state of purity the many useful and beautiful breeds of poultry that are at our command. One of the greatest mistakes made in the past was to assume that because a bird was built on utility lines it could not be a good specimen of the breed it represented. The old

practice of treating phenomenal egg records, the width of the pelvic bones, &c., as the chief qualification of a breeding-bird — which practically meant the ignoring of breed characteristics—is fast passing away. On most successful plants more attention is now being given to the maintenance of breed-type than ever before. Beauty and usefulness are not inseparable, but in the absence of show competition this fact is apt to be ignored, if not lost sight of altogether. Of course, a first cross—that is to say, the progeny of two pure breeds—will sometimes give good results, but it is yet to be proved that from a general standpoint such stock are more profitable than stock bred in a state of purity. If any argument is required to bear out this contention it is surely conveyed by the high egg records produced by purebred stock in the egg-laying tests. In any case it takes two pure breeds to produce a first cross.

Having purebred stock, the next great essential is points indicative of constitutional vigour. It cannot be expected that a bird bred from a weak parent will have the stamina to withstand the great strain on the body which heavy egg laying entails, nor have the power to digest and assimilate the food necessary for the production of a large number of eggs. Profitable production implies profitable stock, and the securing of this rests chiefly on the class of stock mated. Many poultry-keepers, especially farmers, make the common mistake of using eggs for hatching purposes from the whole of the flock, whether the birds be good, bad, or indifferent. Such a practice soon leads to deterioration of a flock, however well they may be bred. If a flock is to be built up and maintained, nothing but specially selected birds should be bred from. Just as the dairyman selects or rejects his cows from a breeding standpoint on the quantity of butterfat they produce, so must the good layers (also possessing the other necessary breeding qualifications) be selected in the case of poultry. This means the necessity of a breeding-pen and mating the best specimens by themselves. No poultry plant is complete without a breeding-pen. It must always be remembered that it is more profitable to have, say, one hundred pullets bred from specially selected stock than double the number bred from indifferent stock.

General Appearance.

As a guide to the novice the following points may be mentioned as indicative of strong constitutional vigour in both sexes. A clean face free from wrinkles and feathers, prominent bright eye, short stout beak, legs set wide apart, short shank, tight feathering, and a well-developed crop. Hand-in-hand with these points should go signs suggestive of laying-power, such as a long deep body, and a well-developed abdomen, soft to the touch, surrounding the abdominal region. In addition, the back should be broad, while generally the bird should present an alert, businesslike appearance. Birds with coarse heads, long thin beaks, heavy feathered eyebrows, dull sunken eyes, and wrinkled skin surrounding the eye, usually indicate poor egg-capacity and low vitality, and obviously should not be bred from.

As to size, it is now generally recognized that the medium-sized bird of its breed is the best layer. It should, however, be clearly understood that the most productive hen is not necessarily the best bird to breed from. The danger of improving one character by weakening

another should always be kept in mind. It is always advisable to choose for the breeding-pen the hen of a slightly larger size than that of the ideal layer: this for the reason that when breeding for heavy egg-production there is always a tendency for the stock to decline in weight rather than to increase. In short, the small individuals will come soon enough to vex the breeder even when nothing but large specimens are bred from.

Size of Eggs.

Another important qualification in the breeding-hen is that she be a layer of good-sized marketable eggs. As things point there is every reason to believe that in the near future our eggs will have to face keener competition on the oversea market than has been the case in the past. To meet this growing competition nothing less than a 2 oz. product is required. On the local market, where there is no outside competition, and under the present system of selling by count, an egg scaling 1¾ oz. realizes as much as one of 2 oz. or more. On the London market, however, it is entirely different. Eggs are paid for not only according to their internal quality but their weight as well; and the sooner this fact is realized by the producer the sooner will the export trade be placed on a sounder footing. The fact of having to include a 1⅞ oz. product in export shipments (as was the case last year) in order to remove the small existing surplus beyond local requirements is sufficient to indicate that the matter of small eggs is one of the most important problems to be solved if maximum returns are to be secured from the export trade. The weak argument used by those who favour shipping the 1⅞ oz. product is, "We are going to sell our eggs at a price f.o.b., and if the grade suits the buyer nothing more is required." Be this as it may, the fact remains that if the size of the eggs were consistently increased the price would be increased accordingly. After all, if a sound export trade is to be built up and a keen demand created for New Zealand eggs, it is the quality that appeals most to the oversea consuming public (not necessarily the speculator) which calls for first consideration; and it is certainly not the egg weighing less than 2 oz. that will appeal most in catering for the high-class trade.

The existing problem of the small egg can be solved only by breeders taking greater care in the selection of their breeding-stock as well as the eggs intended for incubation purposes. This implies the elimination of diminutive specimens of their breed from the breeding-pen, and using no egg for hatching purposes under 2 oz. in weight.

The Male.

In the mating of stock the male bird has an important bearing—he is more than half the flock. He should, above all things, possess signs of undoubted constitution. Further, he should be the son of a healthy mother with a record of egg-laying performance behind her and a producer of first-grade eggs. He should also possess strong masculine characteristics by being stouter and more cobby than the female. The hen should be feminine in all respects. The feminine-looking male or the masculine female should never be bred from.

MANAGEMENT OF BREEDING-STOCK.

The proper feeding of the breeding-birds is all-important if success is to be assured in the hatching and rearing of the progeny. They

should be put on a special diet. This should be plain, as on no account should the birds be forced for heavy laying; rich food such as meat, milk, &c., should be sparingly provided. The best plan is to supply at all times a mixture of any grains, such as wheat, maize, oats, &c. In fact, the greater the variety of grains fed the stronger will be the hatching-qualities of the eggs, and the easier will the chicks be to rear. The food should be fed in deep litter to induce exercise, this being essential if the birds are to be maintained in a proper breeding condition.

F. C. Brown, Chief Poultry Instructor.

THE APIARY.

WINTER INSPECTION.

THE management of the apiary at this season consists chiefly in making an occasional round among the bees to see whether anything has gone wrong with them. On no account should they be unnecessarily meddled with. Where any doubt exists as to the stores required for wintering it may be necessary to open the hives. However, it is by far the better practice to try and estimate the quantity of stores on hand by lifting the back of the hives. Experienced beekeepers can in this way gauge by weight the stores present. Inexperienced beekeepers will, of course, have to examine the combs. If it is necessary to do so, choose a fine day, and in any manipulation that follows on no account break up the cluster of bees. After examination, close up the colony as soon as possible in order to conserve the heat. If a colony is found deficient of stores, a comb or two of honey or a cake of candy laid on top of the frames over the cluster will help considerably. At this season of the year bees will not take syrup readily. If combs of honey are on hand and feeding is carried out, place the combs on the outside of the cluster. To place them in the centre of the cluster will be the means of dividing it, and this will result in much harm to the bees and probably bring about their death.

MATS AND COVERS.

After heavy rains it is well to examine the mats over the frames. If any damp ones are found, replace with dry ones. A supply of mats should always be on hand. It will only be necessary to gently lift one end of the cover to discover the condition of the mat, and this can be done without disturbing the bees.

All covers that are not absolutely rainproof should receive attention. No better covering for roofs can be had than sheet lead. Such covers are costly to commence with, but are rainproof and do not require to be secured in windy locations. If found too expensive, cover the roofs with zinc or ruberoid. If the latter material is used it should be heated before being fixed to the roofs.

REMOVING SPARE TOP BOXES.

All the top boxes that have not yet been removed should now be taken off and the bees confined to the brood-chambers. Breeding will

commence shortly in colonies of normal strength in the warmer parts of the Dominion, and the hives should be made snug with well-fitting mats to conserve the heat of the hives. If it is found that the bees have taken to a top box entirely, remove the lower one and put the former in its place.

—*E. A. Earp, Senior Apiary Instructor.*

HORTICULTURE.

PRODUCE IN STORAGE.

POTATOES, onions, and other produce in store are frequently seriously depreciated by neglect, particularly when careful grading has been omitted. A thorough examination of the condition of such produce should be made from time to time so that it may be marketed without loss. Any dampness or heating will quickly cause sprouting and decay, but this may be avoided by suitable ventilation and drying. The danger of heating is greater where large bulks are stacked in a compact manner. If tipped into bins they should not be very deep, and if the store is small, with comparatively little air-space, the more ventilation will be required.

VEGETABLE CROPS.

Spring cabbage and cauliflowers planted out towards the end of autumn will now commence to renew their growth, and will require hoeing in fine weather to check the competition of weeds. When some growth has been made they may be judiciously fed with fertilizers now and again, as required to produce the crisp vigorous qualities that are desirable in these crops. Where autumn-sown peas are grown they will require somewhat similar attention.

The preparation of the lighter and warmer land for the early and also the hardier main crops should now be completed by occasional cultivation when dry, in order to clean the ground by sprouting and destroying the seeds of weeds. During the coming month the main-crop cabbage, cauliflower, lettuce, and onion plants sown in late autumn may be planted out on such lands. In most instances a moderate dressing of suitable fertilizers should be worked in with the cultivator a short time before planting.

Shallots, garlic, and artichokes may also be planted. Broad beans, peas, spinach, and main-crop cabbage and cauliflower seed may be sown when the conditions are suitable.

Where the practice of sowing the onion crop in spring is adopted, the earliest opportunity of carrying out the work should be taken. By doing so the bulbs are well forward before the period when the more serious fungus blights are prevalent, and they may also be harvested to greater advantage during the warmer months.

CROPS GROWN UNDER GLASS.

Another season now commences in this section with the sowing of tomato and cucumber seeds for planting out under glass towards the end of August. Next in importance to seed strain is the need of

growing plants that are of good, strong texture. This condition is obtained chiefly by growing them steadily from the start. Rapid growth is apt to be very encouraging to the grower, but the satisfaction is entirely misplaced, as such a plant will be seriously checked when planted out, and will take valuable time in making a recovery. There is hardly any exaggeration in stating that temperatures too high are as serious as those which are too low, yet this is rarely realized. The ventilation of the house is best left to one person, who will get accustomed to its working. A temperature of 55°–65° F. is best for tomatoes, and a slightly higher range for cucumbers. If the temperature is inclined to exceed the maximum, ventilation must be given to steady it. By such means, and the use of water of about the same temperature as the glasshouse, the desired type of plant may be grown, and early fruit which secures the higher prices is obtained.

It is also time to complete the preparation of the glasshouses in which the plants are to be planted out. It is necessary that the houses should be thoroughly cleaned, and the land given the requisite amount of cultivation and manures in time for it to consolidate into a firm condition. Houses that have been kept close and allowed to become very dry will require to have the ground thoroughly saturated with water, so as to bring the soil back into a state of fertility.

Some unheated houses that were subject to damage by spring frosts were successfully brought through the danger period last season with the assistance of electric radiators. The wires were piped along the apex of the roof with plug sockets placed at intervals. Half a dozen small radiators are quickly placed into position by means of plugs and cords, and just as quickly removed and stored away when the need for them passes. This method has given excellent results, and with a clocked switchboard the current may be obtained at night, when it is most required by the grower, at a reduced rate that is reasonable for the service obtained.

SEASONABLE WORK IN THE BERRY BRAKES.

With the greater demand for berry fruits, there is an increased interest being taken in the growing of currants, gooseberries, raspberries, loganberries, and strawberries, and some very fine work is being done. There is, however, much room for improvement in many gardens in the way of pruning, spraying, and feeding. Attention to these matters now is the best way to avoid the melancholy study of disease when a heavy crop should be ripening. There is no method of growing good crops continuously without careful attention to these matters. Neither is it satisfactory to prune the bushes and set a heavy crop unless manures are given to enable the plants to develop the berries.

After pruning, manures may be applied and ploughed in, and the early flowering kinds given a good application of a carefully prepared bordeaux spray.

TOBACCO BARNS, SEED-BEDS, AND FIELDS.

In the barns the baling and despatch of cured leaf will now bring the season to a close. Handling dry leaf and packing slack bales are two points to be carefully guarded against. Leaf so packed is almost a total loss after transportation. While the leaf-stems must be thoroughly

dried out, the blade of the leaf must contain sufficient moisture to allow it to be handled without breakage. If it is then firmly packed into bales with the help of a press it will arrive at its destination in creditable condition. Presses need not be elaborate or expensive, although such may be a convenience where a great deal of work has to be done with them.

As the first seed-beds for the new season are made during the month of August, it is already time to commence the necessary preparation. While it is desirable to have the beds near the homestead to facilitate the necessary supervision, care must be taken to avoid fouling the land with tobacco-diseases by successive sowings in the same place without sterilization; even with it the land is often impoverished by loss of humus and other properties. No precaution should be neglected to secure early, healthy plants. The site for the seed-beds must be warm and sheltered, and the soil well drained. Where it is decided to sterilize the top soil, the method of the Maori kumara-cultivators may be adopted. Brushwood is piled to a depth of 3 ft. to 4 ft. and burnt, thus heating the soil sufficiently to a depth of a few inches to destroy organic life. The land in this case is afterwards given only a shallow cultivation of 3 in. or 4 in., so as to retain the treated soil. In some localities glass sashlights would be of value for the protection of this first sowing.

The necessary seed should be obtained now, if it is not already in hand, and care taken to get the best quality of a suitable variety. It is also desirable to test it for germination, so that it may be sown as thinly as possible. Seed should also be obtained from clean plants, as plants readily carry some serious diseases. A teaspoonful of average seed will sow 10 square yards—sufficient plants for an acre of land; and an ounce is sufficient seed for plants for 5 or 6 acres.

The field in which the plants are to be placed also requires consideration. The selection and preparation of this land is often left until it is too late to be effective, and then the cutworm pest is bad and constant weeding is required. An early light ploughing to allow all grass and weeds to decay is often good preliminary treatment, to be followed, when that is accomplished, by a second ploughing that is rather deeper and crosswise. The most suitable land for the tobacco crop is a friable soil of fair quality, well drained, and lying in a sunny position well sheltered from prevailing winds, which do serious damage by bruising and tearing the leaves.

—*W. C. Hyde, Horticulturist.*

Honour for Dr. L. Cockayne.—Another scientific honour has been conferred on our esteemed contributor, Dr. L. Cockayne, F.R.S., of Wellington. At the last annual meeting of the Botanical Society of America he was elected a corresponding member of that body. During the twenty years of the society's existence only fifteen such memberships have been accorded by it throughout the world, including four in the British Empire, Dr. Cockayne's being among the latter.

Destroying Californian Thistle.—Small patches of Californian thistle in a fairly clean grass-paddock may be killed out by sinking a post firmly in the middle of the patch. The cattle, rubbing themselves on the post, will tramp the surrounding ground bare. Another similar method is to place a lump of rock salt on the patch.

WEATHER RECORDS: MAY, 1927.

Dominion Meteorological Office.

GENERAL SUMMARY.

MAY is regarded as the last month of autumn, and was this year rather cooler and more changeable than usual—in fact, the last week may be described as the commencement of winter.

While the first part of the month was dry and the days sunny, yet the earth radiated its heat at night so that there were several severe frosts. On the 12th 20 degrees of frost were registered at Hanmer Springs; and earth-temperatures were generally lower than the average. These frosts did not occur in the cold and wet weather at the close of the month, the clouds then blanketing the earth and the rainfall distributing a certain amount of latent heat. There was, however, on the morning of the 31st a frost of 14 degrees at Christchurch, which is the lowest temperature on the grass ever recorded there in May.

Rainfall was below the average in Otago and South Canterbury and between Farewell Spit and Westport in the South Island, and in Hawke's Bay and Poverty Bay in the North Island, but was considerably above the average in most other parts of the country. Rainfall was particularly heavy about the 26th, 27th, and 28th, when a westerly storm area combined with a disturbance from the north. Total rainfalls at some of the stations were as follows: Arthur's Pass, 17·85 in.; Otira, 20·92 in.; Greymouth, 10·59 in.; Ross, 15·33 in. In the far North, Puhipuhi Plantation had an unusually heavy total of 12·59 in., and Waihi registered a total of 10·89 in. for the month. On the other hand, Christchurch was 80 per cent. and Waiau 85 per cent. below the mean for the month.

There were several windy periods, but on the whole the month was fairly calm. Except in the dry areas there was a good growth of autumn feed.

RAINFALL FOR MAY, 1927, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	4·98	9	1·86	5·06
Russell	6·78	14	1·78	5·15
Whangarei	7·05	10	2·36	6·70
Auckland	5·48	18	1·96	4·50
Hamilton	6·13	21	2·42	4·54
Kawhia	7·24	18	1·74	4·77
New Plymouth	6·61	19	1·34	6·15
Riversdale, Inglewood	12·19	18	2·81	9·82
Eltham	7·57	16	2·42	5·27
Whangamomona	8·31	17	2·83	6·59
Tairua	6·18	17	2·62	6·11
Tauranga	5·32	14	1·79	5·16
Maraehako Station, Opotiki ..	7·02	9	2·66	5·70
Gisborne	3·43	16	0·97	5·67
Taupo	6·19	10	2·17	3·60
Napier	2·92	14	1·03	3·74
Maraekakaho Station, Hastings ..	2·31	14	0·61	3·52
Taihape	3·71	15	0·85	3·84
Masterton	4·07	15	0·96	4·03
Patea	5·87	15	1·60	3·91
Wanganui	3·13	10	0·69	3·42
Foxton	6·40	10	1·36	2·78
Wellington	5·77	13	2·75	4·76

RAINFALL FOR MAY, 1927—*continued.*

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.
South Island.				
	Inches.		Inches.	Inches.
Westport	6·50	15	1·12	6·58
Greymouth	10·59	15	2·58	8·01
Hokitika	13·99	12	3·71	9·71
Ross	15·33	11	4·15	9·73
Arthur's Pass	17·85	13	3·50	11·02
Okuru, Westland	16·39	16	2·77	11·60
Collingwood	8·12	15	1·49	10·18
Nelson	3·65	8	1·07	3·08
Spring Creek, Blenheim ..	3·37	6	1·90	3·19
Tophouse	7·08	12	2·65	5·94
Hanmer Springs	3·48	10	0·85	4·47
Highfield, Waiau	0·50	5	0·16	3·41
Gore Bay	1·25	6	0·60	3·83
Christchurch	0·53	8	0·21	2 65
Timaru	0·50	5	0·26	1·41
Lambrook Station, Fairlie ..	0·54	5	0·18	1·53
Benmore Station, Clearburn ..	1·29	9	0·54	1·75
Oamaru	0·83	5	0·47	1·61
Queenstown	2·11	10	0·70	2·63
Clyde	0·70	6	0·22	0·97
Dunedin	2·29	10	1·20	3·23
Wendon	1·61	9	0·66	2·31
Gore	1·63	15	0·58	2·71
Invercargill	2·70	19	0·42	4·46
Puysegur Point	9·10	17	0·78	6·81

—*D. C. Bates, Director.*

WHEAT AND OATS THRESHING RETURNS.

RETURNS of actual threshings received by the Government Statistician up to 19th May from threshing-mill owners showed that until then totals of 5,436,622 bushels of wheat and 2,937,341 bushels of oats had been threshed out. The average yield per acre in cases where particulars of areas were furnished (covering 99 per cent. of total threshings) worked out at 38·02 bushels for wheat and 43·25 bushels for oats. The figures for the Canterbury, Otago, and Southland Land Districts respectively were as follows: Canterbury—Wheat, 4,543,938 bushels threshed, averaging 38·43 bushels; oats, 1,640,513 bushels threshed, averaging 42·06 bushels. Otago—Wheat, 715,293 bushels, averaging 37·68 bushels; oats, 696,868 bushels, averaging 47·18 bushels. Southland—Wheat, 18,177 bushels, averaging 35·67 bushels; oats, 468,465 bushels, averaging 44·87 bushels per acre.

PRECAUTIONS AGAINST FOOT-AND-MOUTH DISEASE.

FULL information was placed before the Board of Agriculture at its last meeting in regard to the incidence of foot-and-mouth disease in Europe, and the regulations made for the prevention of the introduction of the disease into the Dominion were reviewed. The Board decided that it could not recommend any relaxation of the regulations except in so far as the importation of cattle from the Island of Jersey was concerned. Jersey still enjoys freedom from the disease, and in the circumstances the Board decided to recommend that cattle be allowed entry from there, provided arrangements can be made for them to be transhipped in open water without landing in Britain.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

RABBIT-POISONING WITH PHOSPHORIZED POLLARD.

J. F. C., Rangataua :—

I should be glad to know (1) the best time for poisoning rabbits with phosphorized pollard; (2) whether it is safe to lay the poison in the same paddock with sheep, and, if not, how long should the paddock be left empty?

The Live-stock Division :—

(1) The best time to poison varies in different parts of the Dominion. In your locality the best time for winter poisoning is during June and July, and for summer poisoning in February and March. It does not follow, however, that successful phosphorized-pollard poisonings are not obtainable at other periods. Many settlers successfully patch-poison their lands throughout the whole year, and, if rabbits are increasing, a poisoning between the winter and summer is often necessary. (2) While, in most cases, poison can be safely laid in large paddocks in which sheep are running, it is always advisable to act on the rule that "prevention is better than cure," and to remove the sheep while poisoning is being done, leaving the paddock empty for about a month, unless in the meantime good rains have destroyed the poisoned baits. In small paddocks it is in all cases advisable to remove the sheep when poisoning; and if the poison is laid in a plough-furrow or on sods in well-defined lines that which has not been taken by the rabbits can be picked up or covered over after the lapse of a fortnight or so, after which the sheep can be turned on again.

GERMINATION OF TREATED SEED WHEAT WHEN SOWING DELAYED.

"WHEATGROWER," Methven :—

Will you please inform me to what extent germination of wheat is affected by (1) formalin, and (2) the usual bluestone mixture, if the grain has to be kept (owing to break in the weather, for instance) a week or a fortnight, or even longer? I am told that not more than 25 per cent. will germinate after forty-eight hours if pickled with formalin.

The Fields Division :—

(1) Formalin: The germination of formalin-treated wheat is undoubtedly lowered by each day's delay in sowing, but the actual amount is dependent on several factors. (*a*) The drier the treated wheat becomes, the greater the loss in germination. Your informant is right that germination will probably be reduced by 75 per cent. in forty-eight hours if the treated wheat becomes thoroughly dry and the atmospheric humidity is low, or if it is sown in dry soil. If kept moist and sown following rain the loss due to the treatment will not be so severe; but moulds grow well on formalin-treated seed and will severely injure it if kept more than a few days in a damp condition. (*b*) Farmers as a rule use an overconcentrated formalin solution, which materially increases both the initial damage and the loss on keeping. A strength of 1 pint of commercial formalin to 60 gallons of water (1–480) is recommended. (*c*) Wheat that is low in vitality, or that has been severely handled during threshing, is very liable to injury following formalin treatment. (2) Bluestone: The "usual" bluestone treatment is, like that of formalin, far too strong and does much unnecessary damage. A solution-strength of 1 lb. bluestone to 10 gallons water is quite sufficient to control stinking-smut. Deterioration of wheat after treatment at this strength is not so rapid as with formalin, nor is the grain materially affected by drying—the actual loss in any particular case depending on the condition and variety of the seed.

PERIOD OF HEAT IN EWES.

J. DRIVER, Okoia :—

I have been asked several times lately how often a ewe comes on heat—or, rather, how long there is between the periods, assuming she is not in lamb. I should be obliged if you could give me information on the subject.

The Live-stock Division :—

Sheep, unlike other domesticated animals—for example, the cow—do not have regular periods of œstrum (heat). Desire for the male usually shows about March, lasts for a few days, and, if not gratified, reappears a few times at short intervals. Presence of the ram among the ewes earlier in the season will bring on œstrum at that time. When in season, a slight discharge from the vulva is noticeable.

SYSTEM IN MANURIAL TOP-DRESSING OF GRAZING-COUNTRY.

"BASIC SUPER," Waipukurau :—

I should be glad of an opinion on the following case : A man owns 1,000 acres of second-class land ; the grass consists mostly of agrostis and danthonia, and carries about a sheep to the acre, with some cattle to keep the roughage down. The place is not overstocked, but the sheep are not thrifty. The property has been in grass for a great many years. The owner intends to try top-dressing, but is not in the position to spend large sums this year. Would it pay him best to concentrate on one paddock, or to divide his manure among a number of paddocks —top-dressing certain portions of them, to enable all the sheep on the farm to get some phosphate, which, it is plain, the land is lacking in ?

The Fields Division :—

It is noted that apparently only a very limited amount is to be expended in manure. It would certainly be unwise to treat only portions of a number of paddocks in the endeavour to reach all the stock with some phosphate. Such a method would make it impossible to control the grazing and proper management of the untreated areas in each paddock. The landholder should concentrate with manures on one block at a time, extending to other blocks as early as opportunity permits ; and care must be exercised not to miss any portion of a block, otherwise the effect would be to draw stock away from untreated portions. The management in shifting stock from time to time would permit of distributing the effects of the phosphate on the block being treated. Such an area would be particularly useful for rearing hoggets.

PIG-RAISING POINTS.

C. W. COWAN, Ruatorea :—

I propose to fatten pigs, and would be glad of advice. I will have about 30 gallons of milk daily, and am putting in 2 acres of lucerne, and will have another 2 acres of rough pasture for them to run on. For late autumn feeding I am putting in 1 acre of artichokes and 1 acre of maize. The land is good, and will grow good lucerne and maize and artichokes. I propose buying weaners in September. Kindly inform me—(*a*) How many weaners it would be advisable to buy to do well and fatten ; (*b*) how long I should have to keep them to attain, say, 140 lb. ; (*c*) what would be a good ration of meal to the foregoing ; (*d*) is it advisable to feed skim-milk warm, twelve hours old, or sour ; (*e*) when to plant artichokes to be fed off about 1st April.

The Live-stock Division :—

In the first place, we may state that it would be more profitable to breed your own pigs than to buy weaners. Taking your queries seriatim : (*a*) The acreage mentioned for lucerne, maize, artichokes, and skim-milk should provide sufficient food for five good breeding-sows and their progeny, while if your crops are good it would probably carry more ; if possible, the sows should be purchased before the spring, but if they are not obtainable you should procure and carry on with about fifty weaners till February, and then forty more through next winter. (*b*) It

takes about five and a half to six months to produce pigs weighing up to 140 lb. and 150 lb. dressed weight. (*c*) A good ration comprises green lucerne, milk, and maize (grain) from 1 to 3 per cent. (*d*) It is best to feed skim-milk a few hours after separating—not sour. (*e*) Artichokes are planted in early spring, and are well matured for feeding off as from June; early April is too soon to commence feeding artichokes, as at that time of the year you should have some green feed available, such as maize, millet, or rape.

ARTICHOKE TUBERS FOR SEED.

HARRISON AND SAUNDERS, Marua :—

We have a small area of Jerusalem artichokes which it is our intention to keep for seed for the coming season. Should we remove the tubers from the ground when the tops are thoroughly withered, or allow them to remain till the planting season? If digging is advised, what is the best method of storing the seed? What is the correct time for planting, also best manurial dressing? The land is heavy, with clay subsoil, and somewhat wet.

The Fields Division :—

It is best to leave the seed in the ground until you are ready to plant next season. If the tubers are raised and stored they are inclined to go soft. The best time for planting is when the danger of frost is over, which in your district probably is fairly early in the spring. The following manurial mixture should give good results: Superphosphate, 5 parts; blood-and-bone, 3 parts; 30-per-cent. potash salts, 2 parts: total, 10 parts—using 4 cwt. to 6 cwt. per acre. The soil you mention is not the most suitable, as artichokes do best in soils that suit potatoes. You should endeavour to make the heavy clay more friable by ploughing in a green crop such as oats or mustard. The drainage should also be improved.

ORCHARD SPRAYS AND LIVE-STOCK.

S. J. V., Wanganui :—

I have an orchard of approximately ½ acre, and am thinking of running two breeding-sows permanently on this piece, but there is the question of spraying. Should I be justified in keeping the sows there during spraying-time? Have you any records of stock-poisoning by lime-sulphur or arsenate of lead? Can you advise any substitute for arsenate of lead for codlin-moth?

The Live-stock Division :—

You would not be justified in keeping the sows in the orchard during spraying operations. Both arsenic and lead are deadly poisons, also any combinations of the two. Cases are on record in which cattle have died from the ingestion of grass on which arsenate has been spilled; also with cattle allowed to remain in a paddock in which blackberry was sprayed with arsenate. The Horticulture Division advises that at present there is no effective substitute for arsenate of lead for controlling codlin-moth or other caterpillars on fruit-trees.

DESTRUCTION OF "NATIVE HEATHER."

H. SMITH, Pongaroa :—

Could you give me any advice on eradicating the serious weed known in this locality as "native heather"? I have tried the only means within my knowledge—grubbing, and then burning and crushing with cattle. Both ways are expensive, and so far by no means permanently effective.

The Fields Division :—

Up to the present no practical method of destroying the scrub commonly known as native heather (*Olearia solanderi*) is known, other than grubbing and burning as you are doing. This plant is common on many of the poorer types of soil, which makes the position all the more difficult, as the expense of grubbing, &c., is recurrent.

CLEARING OF MANUKA.

F. A., Ashhurst :—

I am having cut small patches of manuka that is making its appearance in some of the paddocks. As there seems to be a difference of opinion as to after-treatment, I should be glad of advice as to burning or not.

The Fields Division :—

Whether the cut manuka should be burned or not depends on its density. If after chopping it is dense enough to carry a good hot fire it is advisable to burn. The approved method is to chop manuka during late winter or spring and let it lie until autumn before firing, thus encouraging as far as possible the germination of seed previously dropped. It is considered that a good hot fire will destroy these young seedlings as well as the seed which may have matured on the chopped bushes. If the patches you mention are composed of small, thinly distributed plants it is better not to attempt firing.

REGULATIONS FOR IMPORTATION OF GRASS-SEED FROM AUSTRALIA.

THE regulations under the Stock Act, relating to the importation of grass-seed from Australia, made on 21st December, 1925, have been revoked, and the following regulations made in lieu thereof :—

1. For the purpose of these regulations — The term "grass-seed" includes lucerne-seed, clover-seed, and millet-seed: "Statutory declaration" means a declaration made in accordance with the provisions of the Imperial Act now known by the short title of "The Statutory Declarations Act, 1835," or of any Act passed in substitution for or replacing that Act, or containing similar provisions to that Act, and for the time being in force in the State in which such declaration is made.

2. The introduction of grass-seed grown in the State of Queensland or the tick-infestation quarantine-area of New South Wales is prohibited.

3. Grass-seed grown in the State of New South Wales, elsewhere than in the tick-infestation quarantine-area, may be imported into New Zealand subject to the following conditions : (*a*) That prior to shipment to the Dominion it has been subjected to fumigation by carbon bisulphide, at a strength of 10 lb. to 1,000 cubic feet of chamber-space, for a period of not less than twenty-four hours; and (*b*) that it is accompanied by a statutory declaration made by the consignor, in the form or to the effect of the First Schedule, and also by a certificate appended thereto, signed by an officer of the Department of Agriculture of that State, in the form of the Second Schedule.

4. Grass-seed grown in the States of Victoria, South Australia, Western Australia, and Tasmania may be imported into New Zealand subject to the following condition : That it is accompanied by a statutory declaration made by the consignor, in the form or to the effect of the Third Schedule.

5. No person shall introduce or import, or attempt to introduce or import, grass-seed into New Zealand in contravention of these regulations.

The regulations came into force on date of publication in the *Gazette* of 19th May. The Schedules comprising the various forms may be seen therein.

FORTHCOMING WINTER SHOWS.

Rotorua A. and P. Association : Rotorua, 21st to 23rd June.
Taumarunui Winter Show Association : Taumarunui, 15th and 16th July.
South Taranaki Winter Show Company : Hawera, 29th June to 6th July.
Wellington Winter Show Association : Wellington, 15th to 30th July.
Auckland Winter Exhibition : Auckland, 21st to 30th July.

Secretaries are invited to supply dates of their shows for publication in this list.